The American Midland Naturalist

Devoted to Natural History

Primarily that of the Prairie States

Founded by J. A. Nieuwland, C.S.C.

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A Revision of the Genus Ashmeadiella (Hymen., Megachilidae)

Charles D. Michener

The genus *Ashmeadiella* was proposed by Cockerell in 1897 for the reception of certain western bees of the subfamily Osmiinae which had previously been placed in *Heriades* but which have no close relationship to that genus. For many years *Ashmeadiella* has been regarded as a relatively small group, but it is now evident that it is one of the largest genera of Osmiinae.

Phylogeny

Ashmeadiella appears to have developed from *Osmia*, a genus of holarctic distribution far more diversified and probably much older than *Ashmeadiella*. The similarities of the two genera are marked. The more generalized, widely distributed subgenus of *Ashmeadiella* has a truncate clypeus with brushes under its margin and tridentate mandibles in the females, as in many species of *Osmia*. The possibility that *Osmia* developed from *Ashmeadiella* is remote. The wide distribution and great diversity of *Osmia* indicates its great age, and in *Ashmeadiella* the large number of closely related species in a limited region indicates that it is neither an old nor a relict group.

The particular section of *Osmia* from which *Ashmeadiella* arose cannot be stated, but it seems safe to assume that the metallic forms with punctiform notalices, so common now in North America, do not represent the type of insect which was ancestor to *Ashmeadiella*. A more likely group would be species similar to *Osmia besseyae* Cockerell and *O. albomarginata* Cockerell, which are hardly metallic, have linear notalices like those of *Ashmeadiella*, clypeal and mandibular character like those of the more primitive *Ashmeadiella*, and which now occur in the region where one would expect *Ashmeadiella* to have developed.

Since *Ashmeadiella* is most abundant and diversified in the western part of the Great Basin and in the deserts south of this, it seems possible that the genus arose in response to arid conditions as these regions became dry and unsuitable for *Osmia*, which now occupies them only to a limited extent, but which is abundant in the more humid regions on either side. Perhaps a more likely assumption is that the genus already occurred in this area, and as it

became arid, adapted itself more readily than *Osmia* to the changing conditions and became abundant in the region. If this is true, it is possible that some of the species now widely distributed, such as *bucconis*, or some of the species now found on the periphery of the range of the genus, such as *floridana*, are derivatives of ancient species which were already widely distributed before the Great Basin region became dry. Certain other groups appear to have had a history similar to that of *Ashmeadiella* in so far as their relations to arid regions are concerned. Thus the wasp genus *Pterocheilus* is widely distributed over the holarctic region, but is most abundant both in individuals and in species in the deserts of both North America and Asia. It is also interesting to observe that the distribution and center of abundance of the bee genus *Perdita* corresponds closely to that of *Ashmeadiella*. Several other groups of Osmiine bees (e.g. *Osmia timberlakei* Cockerell) may have developed, like *Ashmeadiella*, along the western edge of the Great Basin. As in

Fig. 1. Map of North America, showing the distribution of the subgenera of *Ashmeadiella*. Line 1 encloses the area occupied by *Ashmeadiella* s.str.; 2. *Arogochila*; 3, *Chilosima*; 4, *Corythochila*; 5, *Cubitognatha*. The known localities for *Titusella* are marked by x.

Ashmeadiella they are small, non-metallic species. Unlike the latter genus they have not spread far from their points of origin, and have never been collected outside of eastern California.[1] I believe that they are probably derivitives of *Osmia,* parallel to, but of much more recent origin than, *Ashmeadiella.*

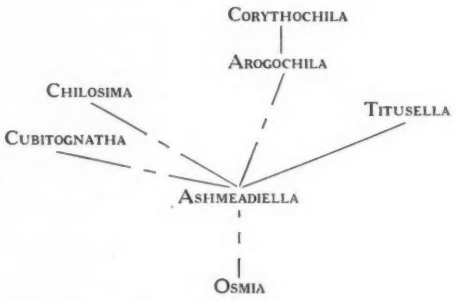

Fig. 2. Diagram indicating possible relationships of the subgenera of *Ashmeadiella.* Unbroken lines indicate fairly complete intergradation between subgenera so connected. Broken lines between subgenera indicate absence of such intergradation among known species.

Although the time at which *Ashmeadiella* originated cannot be definitely postulated, the time at which it became abundant in our western deserts must have coincided with, or closely followed the appearance of these deserts. It is interesting to note that in the southern part of the desert especially, *Ashmeadiella* is a conspicuous element of northern origin[2] in a biota largely derived from the south. Similarly, the vertebrates of the region are also of northern origin. Moreover, they must be recent. Can it be that *Ashmeadiella* is of an age comparable to that of the modern groups of vertebrates? The indications are that most insect genera are older than this.

The genus is divisible into several subgenera, as more fully indicated below. The distribution and relationships of these are of interest. The subgenus *Ashmeadiella* s.str. is, I believe, the most primitive, and from it the other subgenera arose. Its characteristics are much like those of certain species of *Osmia;* the clypeus is somewhat produced and truncate with a pair of brushes under its margin, and the mandibles are relatively short and tridentate in the females. Although best represented in the western Great Basin, both in individuals and species, this subgenus extends to the Atlantic coast, Yucatan, and southern British Columbia.

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1 Although the bee-fauna of the deserts of Nevada, Utah, and Arizona is not well known, that of New Mexico is quite well known. These bees have not been found there.

2 *Osmia* is northern and there are no Osmiinae in South America.

There is a series of species showing rather complete intergradation between *Ashmeadiella* s.str. and the subgenus *Titusella* Cockerell. The members of this series which seems most nearly on a direct line between these groups are as follows: *californica, opuntiae,* and *biscopula.* The first two of these are placed in *Ashmeadiella* s.str., the last in *Titusella.* The trend of modification through this series is one of increasing breadth of mandibles in the females, which finally become quadridentate in *biscopula,* and of increasing breadth of clypeal truncation, which culminates in the broadly concave type of *biscopula. Titusella* is the one group of the genus which is not abundant in the Great Basin region. It is, I suspect, better adapted to life in the mountains and in more humid areas than in the deserts.

The subgenus *Arogochila* is quite distinct from *Ashmeadiella* s.str. and we know of no species intermediate between the two groups. The species of *Arogochila* which is presumably most primitive is *sculleni.* The clypeus and labrum of *Arogochila* are usually highly modified. Each hypostomal carina is produced posteriorly to a tooth in all but the two most primitive species. This subgenus, although best represented in the western part of the Great Basin, extends to the Pacific coast in considerable numbers, and a few species reach Washington, the western parts of the Rocky Mountain states, and northern Mexico. Outside of California and the neighboring states it is very poorly represented. As might be expected from their great morphological specialization, most of the forms of this subgenus whose habits are known are oligotropic.

The subgenus *Corythochila* is a small group, probably derived recently from one of the more primitive species of *Arogochila,* differing from it in the sublaterally angulate, shortened clypeus and in the quadridentate mandibles of the female. One species of *Arogochila, howardi,* has quadridentate mandibles. However, the low inner teeth of the mandibles and the shape of the clypeus indicate that it is not very closely related to *Corythochila.* The known distribution of this subgenus is the desert region of California, Nevada, and Arizona.

The subgenus *Chilosima* is not closely related to any of the others. Presumably it arose from *Ashmeadiella* s.str. Its most striking character is the tridentate mandibles of the male, those of all the other subgenera being bidentate. It ranges from Washington to Lower California and east to southern New Mexico, occuring, in so far as known, always in arid regions.

Cubitognatha is a subgenus known only from one very extraordinary species, found in the deserts of Nevada and eastern California.

The apparent relationships of these six subgenera, as discussed above, are expressed in the accompanying diagram.

Distribution

Ashmeadiella is widely distributed in North America, ranging from southern Canada to Yucatan and from the Atlantic to the Pacific, but is well represented only in the western part of its range. It has not been found outside of North America.

It is interesting to note that the distributions of the various subgenera, plotted on a map, form a series of concentric areas, whose common center is in the western part of the Great Basin, where species and individuals of the various subgenera are most numerous. The subgenus *Titusella* should be excluded from consideration here, since it is primarily a montane group whose dispersal has probably been hindered rather than facilitated by the desert areas. Assuming that among vigorous, still spreading animals, the area occupied by a group of species varies directly with the age of the group, the subgenera of *Ashmeadiella* may be arranged as follows from oldest to youngest: *Ashmeadiella* s.str., *Arogochila, Chilosima, Corythochila, Cubitognatha.* That *Cubitognatha,* known from a single morphologically divergent species, is really as young as this would indicate seems doubtful, yet such may actually be the case. Otherwise the arrangement seems to be in accordance with what little can be learned concerning age by a study of the comparative specialization of the morphological characters compared with those of *Osmia,* as discussed above. As pointed out later, however, I do not wish to be interpreted as believing that the age of the subgroups or the time available for migration since their origin is the only factor responsible for the creation of this distributional pattern.

It is also true that the arrangement of subgenera as given proceeds from that with the largest number of forms to that with the smallest. Inserting now *Titusella,* we have *Ashmeadiella* s.str. with thirty-nine forms, *Arogochila* with fifteen, *Titusella* with four, *Chilosima* with three, *Corythochila* with two, and *Cubitognatha* with one. *Titusella,* although still rare in collections and little known, apparently occupies portions of an area about the size of those occupied by *Arogochila* and *Chilosima,* as will be seen from the map. This arrangement of subgenera suggests that not only does the area occupied by a still dispersing group vary directly with the age of the group, but also that the number of species may vary directly with the age of the group. Parenthetically, it is interesting to note that *Ashmeadiella* s.str., which is found in an area considerably more than twice as large as that of *Arogochila,* the next largest subgenus, also contains somewhat more than twice as many species. Admittedly, our knowledge is still so incomplete that the figures in the latter part of the series of subgenera given above may not be significant. Yet the differences in the numbers of species between the first few subgenera must be of some importance.

All this suggests that from a center of origin in the western Great Basin the various subgenera, with the probable exception of *Titusella,* in the order indicated above, arose and radiated as a series of waves over the continent, the oldest having occupied the greatest territory, the youngest the least, and each remaining in the entire territory which it populated, not being displaced by succeeding waves. That such a thing should happen seems remarkable. Why should not some of the subgenera appear at and radiate from other points? Perhaps *Titusella* is a group in which this did take place. The only explanation which I am able to suggest to account for the apparent common center of origin of the various subgenera is that in the evidently favorable

habitat of the western Great Basin there has been the largest number of individuals and hence the greatest chance for the production of new types which would eventually develop additional species and perhaps subgenera. The Great Basin is also an area of climatic extremes and intense solar radiation, factors possibly responsible in part for extensive speciation there. It is moreover, a region of diverse habitats in close proximity, with many isolated mountain ranges, which would perhaps favor selection of biotypes and the eventual development of new forms.

Since the powers of dispersal of bees appear to be great, it seems very improbable that the restricted ranges of the various species and subgenera should be entirely due to the lack of time necessary for further migration. It seems likely that a species, having once arisen, will rapidly occupy the entire area environmentally suited to it and not separated from its point of origin by impassible barriers. Therefore factors other than age are probably at least in part responsible for the limited distributions.

The migrations of the subgenera must have taken place since the last great climatic changes in most of the area concerned; otherwise there would be no such uniformity in distribution. To a large degree the area now occupied by *Ashmeadiella* was not greatly affected by Pleistocene glaciation, and the dispersal of *Ashmeadiella* could have continued with little interruption through this period. If the hypotheses presented above are correct, they may give some confirmation to parts of the much criticized "Age and Area" theory of Willis. Possibly such distributional effects can be recognized only in those groups which have spread rapidly in an area in which climatic and topographic changes have not been great during the time of dispersal. This implies a recent origin for such groups, since changes of this type must take place at rather frequent intervals.

Biology

The nesting habits of *Ashmeadiella* are not well known, but are evidently diverse. The types of *californica* were reared from nests in twigs. The type of *femorata* was reared from a nest of *Pseudomasaris*, one section of which must have been taken over by the *Ashmeadiella*. In the United States National Museum is a specimen of *Ashmeadiella* s.str. from Texas, associated with and doubtless reared from a small snail shell, the interior of which is plastered with mud.

Many species, especially in *Ashmeadiella* s.str., must breed more or less continuously through a large part of the summer. For example, *californica* has been collected at Riverside from April 11 to November 1. Other species, probably particularly the oligotropic forms in the more specialized subgenera, have relatively restricted seasons of flight in any one place, although climatic variations connected with differences of altitude and latitude may give them a rather long season from the standpoint of their entire range.

The species of the genus have widely different flower-visiting habits. Cer-

tain forms, perhaps the majority of those in the subgenus *Ashmeadiella* s.str., visit flowers of many species of plants. For example, *bigeloviae* is found regularly on flowers of several families, while *bucconis* and *californica* visit many Compositae. However, *opuntiae* appears to be oligotropic on cactus, and *prosopidis* on *Prosopis*. In the other subgenera, the majority of the species seem to be restricted in their regular pollen-collecting visits to single genera of plants. For example, *erema* visits chiefly *Parosela, timberlakei timberlakei, Lotus; timberlakei solida, Astragalus; salviae, Salvia;* and *australis, Pentstemon.*

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Genus ASHMEADIELLA

Ashmeadiella Cockerell, 1897, Ent. News, **8**:197; Cockerell, 1898, Bull. Denison Univ., **11**:41; Cockerell, 1898, Bull. Univ. New Mex., **1**:41; Ashmead, 1899, Trans. Am. Ent. Soc., **26**:73; Cockerell and Porter, 1899, Ann. Mag. Nat. Hist., (7)**4**:404; Cockerell and Atkins, 1902, Ann. Mag. Nat. Hist., (7)**9**:233; Robertson, 1903, Trans. Am. Ent. Soc., **29**:167; Cockerell, 1906, Bull. Am. Mus. Nat. Hist., **22**:445; Cockerell, 1910, Univ. Colo. Stud., **7**:185; Sladen, 1916, Can. Ent., **48**:270.

This genus consists of rather small, non-metallic species. The males are easily distinguished from all other genera of Osmiinae by the four teeth on the posterior margin of the sixth tergite. Both sexes may be distinguished from the other known genera by the presence of weak prepectal carinae separating the smoother, nearly impunctate, anterior parts of the mesepisterna from the large, punctate, hairy outer faces.

Antennae of males not modified; maxillary palpi short, four-segmented; first and second segments of labial palpi not very different in length; notalices linear; prepectal carinae evident; metanotum and propodeum nearly vertical, the latter without a series of basal pits; hind coxae with slight carina within; tarsal segments two to four not broadened; first abdominal tergite with strong anterior concavity, bounded by a carina; sixth tergite of male with four apical projections; seventh tergite of male small, simple, truncate, largely concealed by sixth tergite; sternites of male simple and broadly rounded posteriorly, except for fifth which is slightly bilobed; fifth and sixth sternites of male large but concealed; coxopodites of male genitalia slightly expanded and bent inward subapically, ending in subacute points.

Orthotype: *Heriades opuntiae* Cockerell.

In the keys below much use has been made of the relative positions of the ocelli, antennal bases, and posterior edge of the vertex. It is hoped that these will be comprehensible, but in regard to the position of the anterior ocellus with respect to the antennal bases and the posterior edge of the vertex, it should be stated that the head is to be viewed from the side, as shown in Plate 1, Figs. 1 and 2. Arrows in these figures and in Fig. 3 indicate the manner in which the measurements were made.

The numbers of teeth on the hind tibial spurs mentioned in the descriptions are somewhat variable, and, while they are often useful specific characters, the numbers given should not be too rigidly applied.

The lists of localities given under the species below are made up primarily of previously unrecorded data. This policy has been adopted in order to avoid repetition of long lists of localities already published in other papers.

Among the specimens studied there are a few, mostly from the United States National Museum, which cannot be determined and which probably represent new species. Most of these are unique examples of the subgenus *Ashmeadiella* s.str., a somewhat difficult group in which it seems unwise to describe additional species on the basis of single specimens.

Ashmeadiella howardi Cockerell (female, not male) has been omitted, since it is evidently a *Proteriades*.

Key to the Subgenera

FEMALES

1. Total length of outer side of mandibles, measured along lower carina, at most twice as long as scape; mandibles tridentate; clypeus punctate, produced and truncate, the truncation sometimes concave (Figs. 9-12, Pl. 1).....*Ashmeadiella* s.str.

   Total length of outer side of mandible, measured along lower carina, more than twice as long as scape; clypeus not both produced and truncate (except in *A. (Chilosima) washingtonensis*), if produced, variously rounded or lobate..... 2

2. Mandibles with four or more teeth.[3]..... 3
   Mandibles with two or three teeth, inner tooth sometimes beveled.[3]..... 4

3. Apices of mandibles greatly broadened, distance from first tooth to inner apical angle at least half length of mandible; clypeus short, its apex somewhat lobate, not or hardly produced beyond a line connecting lower ends of eyes. (Figs. 13-16, Pl. 1) .....*Titusella*

   Apices of mandibles not broad, distance from first to fourth tooth distinctly less than half length of mandible; clypeus produced beyond a line between lower ends of eyes, its apex broadly rounded or truncate (Figs. 23-24, Pl. 2) .....*Chilosima*

   Apices of mandibles not broad, distance from first to fourth tooth distinctly less than half length of mandible; clypeus produced but little beyond line between lower ends of eyes, apex variously lobed, sublateral angles large (Figs. 17-18, Pl. 1) .....*Corythochila*

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[3] An occasional specimen of *A. (Chilosima) rhodognatha* has tridentate mandibles due to reduction of the third tooth. *A. (Ramphorhina) barberi* has weakly quadridentate mandibles. Reference to the figures will make identification of these species possible.

4. Mandibles slender, elbowed, bidentate; clypeus short, anterior margin straight, not produced; surface of clypeus impunctate, upper margin strongly elevated ..... *Cubitognatha*

Mandibles more robust, not elbowed, tridentate; clypeus produced and usually variously lobate; surface of clypeus punctate; upper margin not elevated, but on same plane as supraclypeal area ..... *Arogochila*

MALES

1. Mandibles tridentate; lateral teeth of sixth tergite not greatly broadened, lateral margins of tergite not strongly convex ..... *Chilosima*

Mandibles bidentate 2

2. Lateral margin of sixth tergite distinctly and rather evenly convex throughout, lateral teeth broad, apices nearly right angled..... *Corythochila* and *Arogochila*

Lateral margins of sixth tergite straight or only slightly convex or weakly sinuate, at least as seen from above, lateral teeth with apices usually acute ..... *Titusella* and *Ashmeadiella* s.str.

The key to the males of *Arogochila* given below includes also the species of *Corythochila*, while the key to the males of *Ashmeadiella* s.str. includes also the known male *Titusella*.

Subgenus ASHMEADIELLA Cockerell, s.str.

This is the largest and most widely distributed subgenus of *Ashmeadiella*. Females may be easily recognized by the somewhat produced, truncated clypeus, similar to that of many *Osmia*. No other species of *Ashmeadiella* are so characterized except *washingtonensis*, which is otherwise very distinct, belonging to the subgenus *Chilosima*. In all known species of *Ashmeadiella* s.str. the apex of the labrum is rounded. Males, having bidentate mandibles and narrow lateral teeth of the sixth tergite, are apparently indistinguishable from *Titusella*.

Female: Mandibles tridentate, distance from first to third tooth half or more than half length of mandible; mandibles twice as long as scape or slightly less; clypeus with pair of orange brushes under anterior margin, margin produced over base of labrum and truncated, apex extending beyond a line drawn between lower ends of eyes; gular groove not greatly narrowed behind; hypostomal carinae not toothed posteriorly.

Male: Mandibles bidentate, inner margin basad to inner tooth not expanded; gular groove not greatly narrowed behind; lateral margins of sixth tergite not strongly convex, somewhat sinuate; lateral teeth of sixth tergite slender.

Orthotype: *Heriades opuntiae* Cockerell.

KEY TO THE SPECIES OF ASHMEADIELLA, S.STR.

FEMALES

1. Anterior part of clypeus finely and closely punctate, without smooth apical margin, in contrast to upper part of disc of clypeus, which is much more coarsely punctate 2

Anterior part of clypeus sometimes more finely punctate than upper part, but always with a narrow, shiny, sometimes somewhat roughened, apical margin 4

2(1). Abdomen black 3
Abdomen with first two tergites red at sides..... *curriei basalis*

3(2). Pubescence abundant, abdominal hair bands broad; tegulae piceous or testaceous (deserts) ..... *curriei echinocerei*
Pubescence sparser, abdominal hair bands narrow; tegulae black (mountain regions). ..... *curriei curriei*

4(1). Vertex behind ocelli with space wider than ocellar triangle, polished and finely and sparsely punctate, in contrast to adjacent areas. ..... *occipitalis*
Vertex punctured like remainder of head, or sometimes with small smooth area behind ocelli 5

5(4). Anterior ocellus in front of midpoint between bases of antennae and posterior margin of vertex; truncation of clypeus usually slightly sinuate because of a weak, inconspicuous notch on each side of middle; abdomen elongate and parallel sided, coarsely punctate 6
Anterior ocellus at or behind midpoint between bases of antennae and posterior margin of vertex, except in some specimens of *opuntiae* and *californica;* truncation of clypeus not sinuate; abdomen usually broad, comparatively finely punctate 7

6(5). Punctures of cheeks as large as, or larger than, those of mesepisterna; scopa brownish yellow ..... *bucconis bucconis*
Punctures of cheeks smaller than those of mesepisterna; scopa pale yellowish or whitish ..... *bucconis denticulata*

7(5). Clypeus with upper two-thirds polished and very sparsely punctate; inner margins of eyes diverging below. ..... *stevensi*
Clypeus rather closely and finely punctate; inner margins of eyes converging below. 8

8(7). Truncation of clypeus longer than distance from end of truncation to lateral angle of clypeus; ends of clypeal truncation marked by small but distinct, slightly produced, angles; inner carina of outer edge of mandibles extending across mandibles basally, ending distinctly nearer anterior than posterior basal angle of mandibles ..... *opuntiae*
Truncation of clypeus shorter than or equal to distance from end of truncation to lateral angle of clypeus; ends of truncation narrowly rounded or marked by rounded, slightly produced margin; inner carina of mandibles usually ending about equidistant from anterior and posterior basal angles of mandibles (except in *femorata* and *titusi*). 9

9(8). Cheeks as wide as or wider than eyes, seen from side; distance from first to third mandibular tooth greater than length of last three antennal segments together. 10
Cheeks narrower than eyes, seen from side. 12

10(9). Punctures of second tergite medially fine and separated by several times their diameters. ..... *californica sierraensis*
Punctures of second tergite coarser and separated by less than their diameters. 11

11(10). Punctures of upper part of clypeus usually separated by some shiny surface (Rocky Mountain states). ..... *californica florissantensis*
Punctures of upper part of clypeus approximate (Pacific coast) ..... *californica californica*

12(9). Legs partly red (at least hind femora red); abdomen black; pubescence often abundant and white. 13
Legs black, or if partly red, abdomen also partly red. 19

13(12). Outer margin of inner hind tibial spurs with about six very large teeth; hind tibial spurs short and strongly curved at apices. 14

Outer margin of inner hind tibial spurs with eight or more teeth, much smaller and finer than in the above; hind tibial spurs long, slender, not strongly curved. 15

14(13). Clypeal truncation distinctly, somewhat angularly, emarginate; middle femora black. ..... *femorata*

Clypeal truncation slightly, evenly concave; middle femora red. ..... *litusi*

15(13). Distance between posterior ocelli greater than distance to eye margin; anterior margin of scutum with pair of pubescent spots or transverse pubescent area; middle femora red. 16

Distance between posterior ocelli equal to distance to eye margin; anterior margin of scutum without densely pubescent areas; middle femora black or nearly so. ..... *difugita*

16(15). Clypeus with the somewhat shiny apical margin of truncation rather broad and roughened by broad, shallow depressions (punctures); punctation coarse; fore legs black or largely so; outer margin of inner hind tibial spurs with about eight rather large teeth. ..... *bigeloviae*

Clypeus with the shiny apical margin of truncation very narrow, smooth, with the appearance of being minutely reflexed; punctation finer; outer margin of inner hind tibial spurs with about eleven teeth, or if less (eight or more) they are small. (Spurs not examined in *rufipes*). 17

17(16). Fore legs and middle tibiae largely black. 18

Legs except coxae almost entirely red. ..... *haematopoda*

18(17). Length 7½ mm. (California) ..... *rufipes*

Length 6½ mm. (Lower California) ..... *rhodopus*

19(12). Face broad, greatest distance between eyes about equal to length of eye. ..... *maxima*

Face narrower, greatest distance between eyes less than length of eye. 20

20(19). Scutum more coarsely punctured than vertex, punctures mostly separated by somewhat more than their diameters; anterior edge of scutum with a pair of large confluent spots of pubescence; fifth tergite with distinct apical pubescent band. ..... *leucozona*

Scutum with punctures of disk separated by much less than their diameters. 21

21(20). Median ocellus barely posterior to midpoint between antennae and posterior edge of vertex; supraclypeal area considerably more finely punctate than adjacent parts of face. ..... *floridana*

Median ocellus distinctly posterior to midpoint between antennae and posterior edge of vertex. 22

22(21). Dorsum of abdomen red except for sixth tergite; hind femora red. ..... *rufiventris*

Adbomen black or red only basally, sometimes largely red in *rufitarsis* in which the hind femora are black. 23

23(22). Distance between posterior ocelli greater than distance to eye margin; teeth of outer margin of inner hind tibial spurs low and oblique. ..... *schwarzi* and *prosopidis*

Distance between posterior ocelli but little greater than, equal to, or less than distance to eye margin; teeth of outer margin of inner hind tibial spurs high and sharp. 24

24(23). Cheeks less than half as wide as eyes, seen from side; length less than 5 mm.; polished area of propodeum large, so that punctured areas do not reach sides of median pit or lower sublateral pits. ..... *sonora*

Cheeks more than half as wide as eyes, seen from side; length more than 5 mm. (except in *rufitarsis*); polished area of propodeum not unusually large, punctures usually reaching sides of lower sublateral pits. 25

25(24). Sixth sternite with a large, transverse, very coarsely punctate, depressed fovea. ..... *foveata*

Sixth sternite slightly convex, rather coarsely punctate, not foveate. 26

26(25). Finely punctate; tarsi reddish brown, in contrast to rest of legs; length 4 mm. or less; abdomen sometimes reddish. ..... *rufitarsis*

Coarsely punctate; tarsi concolorous with rest of legs; length usually over 4 mm. 27

27(26). Fifth tergite with apical band of white pubescence nearly as distinct as that of fourth tergite. 30

Fifth tergite without distinct apical band of white pubescence except laterally. 28

28(27). Tegulae black; length often over 6 mm. 29

Tegulae usually testaceous; length often under 6 mm. ..... *cactorum aridula*

29(28). Slightly more finely punctate (Lower California). ..... *cactorum crassa*

Slightly more coarsely punctate (southwestern United States, northern Mexico). ..... *cactorum cactorum*

30(27). Truncation of clypeus broadly V-shaped emarginate; width of thorax more than 2 mm. ..... *dimalla*

Truncation of clypeus weakly concave; width of thorax less than 2 mm. 31

31(30). Posterior half of tegulae nearly impunctate. ..... *coloradensis*

Posterior half of tegulae with distinct punctures. ..... *cactorum astragali*

MALES

1. Abdomen black or nearly so, legs at least partly red; pubescence often abundant. 2

Abdomen and legs black, or if legs partly red, then abdomen also partly red. 8

2(1). Inner hind tibial spurs short and rather strongly curved, with about three large teeth on outer side; median teeth of sixth tergite considerably longer than their basal widths. 3

Inner hind tibial spurs straighter, with numerous fine teeth. 4

3(2). Middle femora red; tegulae rufo-testaceous. ..... *titusi*

Middle femora black; tegulae dark. ..... *femorata*

4(2). Median teeth of sixth tergite short, concavity between them about a semicircle; margin of sixth tergite, between lateral and median teeth, straight and about twice as long as lateral teeth; fore legs largely black. ..... *bigeloviae*

Median teeth of sixth tergite longer, so that concavity between them is longer than a semicircle; margin of sixth tergite concave between lateral and median teeth and distance between these usually less than twice as long as lateral teeth. 5

5(4). Distance from posterior ocelli to eye margin less than distance to posterior edge of vertex; middle legs at least partly red; anterior margin of scutum with transverse band of dense white pubescence. 6

Distance from posterior ocelli to eye margin equal to or greater than distance to posterior edge of vertex; middle legs black; anterior margin of scutum without dense pubescence. ..... *difugita*

6(5). Sides of first abdominal tergite, just above lateral angles, very finely and closely punctate, in contrast to second tergite and dorsum of first tergite; median teeth of sixth tergite rather robust, broadened basally; fore legs largely black; length 6½ mm. ..... *rufipes*

Sides of first tergite more coarsely punctate, about as shiny as, and not much more finely punctate than second tergite and dorsum of first tergite; median teeth of sixth tergite slender, at least apically. 7

7(6). Fore legs largely black; median teeth of sixth tergite usually about twice as long as basal width. ..... *rhodopus*

Fore legs nearly all red; median teeth of sixth tergite usually over twice as long as basal width. ..... *haematopoda*

8(1). Vertex behind ocelli with large, sparsely punctate, polished area, broader than ocellar triangle; robust species. ..... *occipitalis*

Vertex rather closely punctate, not noticeably polished as compared with adjacent areas (except in some individuals of *bucconis*, in which there is a small polished area, usually narrower than ocellar triangle). 9

9(8). Anterior ocellus at or in front of midpoint between antennal bases and posterior edge of vertex; median teeth of sixth tergite but little if any longer than broad. 10

Anterior ocellus posterior to midpoint between bases of antennae and posterior edge of vertex, except in some specimens of *maxima*, *opuntiae*, *californica*, etc., in which the median teeth of the sixth tergite are much longer than broad. 12

10(9). Face densely covered with white pubescence; finely punctate species. ..... *(Titusella) clypeata*

Face not densely covered with pubescence, integument visible except on sides of face and anterior margin of clypeus; coarsely punctate species. 11

11(10). Anterior ocellus nearly twice as far from posterior margin of vertex as from antennal bases. ..... *bucconis bucconis*

Anterior ocellus but little farther from posterior margin of vertex than from antennal bases. ..... *bucconis denticulata*

12(9). Distance from posterior ocelli to posterior edge of vertex nearly one and one-half or more times distance between posterior ocelli; anterior ocellus near midpoint between bases of antennae and posterior edge of vertex; median teeth of sixth tergite long (see also *maxima*). 13

Distance from posterior ocelli to posterior edge of vertex hardly more than (at least not one and one-half times) and often less than distance between posterior ocelli. 14

13(12). Cheeks narrower than eyes, seen from side. ..... *arizonensis*

Cheeks as broad as or broader than eyes, seen from side. ..... *opuntiae*

14(12). Anterior ocellus but little if any behind midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli less than or equal to distance to posterior edge of vertex (except in *leucozona*); posterior ocellus, seen in profile, with horizontal space about twice its diameter behind it before vertex begins to slope downward posteriorly. 15

Anterior ocellus considerably behind midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli greater than distance to posterior edge of vertex (hardly so in *microsoma*, *schwarzi*, *digiticauda*, and *bequaerti*); posterior ocellus, seen in profile, with horizontal space about as wide as its diameter behind it before vertex begins to slope downwards posteriorly. 25

15(14). Median teeth of sixth tergite long, one and one-half times as long as broad, except when quite long but broadened basally; concavity between median teeth of sixth tergite longer than a semicircle. 16

Median teeth of sixth tergite short, less than one and one-half times as long as broad; concavity between median teeth of sixth tergite usually a semicircle or shorter than a semi-circle (rarely longer than a semicircle). 22

16(15). Median teeth of sixth tergite broad, their apices separated by about or but little more than twice the width of one of them; tarsi reddish brown. ..... *altadenae*

Median teeth of sixth tergite slender, their apices separated by much more than twice the width of one of them; tarsi largely black, sometimes brown if rest of leg is brown. 17

17(16). Anterior ocellus approximately at midpoint between antennal bases and posterior edge of vertex; large species with broad face. ..... *maxima*

Anterior ocellus usually behind midpoint between antennal bases and posterior edge of vertex. 18

18(17). Pubescence abundant; apical pubescent bands on tergites one to four very conspicuous and white; hairs near angle of coxopodites of genitalia about half as long as width of coxopodite at that point. ..... *dimalla*

Pubescence sparser; abdominal bands weaker, not perfectly white. 19

19(18). More finely punctate, usually larger; hairs near angle of coxopodites of genitalia about as long as width of coxopodite at that point. ..... *californica* and its subspecies

More coarsely punctate, usually smaller; hairs near angle of coxopodites of genitalia about half as long as width of coxopodite at that point. 20

20(19). Tegulae distinctly punctured posteriorly and exteriorly..... *cactorum astragali*
Tegulae weakly punctured though slightly roughened. 21

21(20). Tegulae usually black; larger form. ..... *cactorum cactorum*
Tegulae usually testaceous; smaller. ..... *cactorum aridula*

22(15). Punctures of disc of scutum large and separated by almost their diameters; cheeks about half as wide as eyes, seen from side; anterior ocellus considerably behind midpoint between antennae and posterior edge of vertex. ..... *leucozona*

Punctures of disc of scutum finer and but little separated; cheeks almost as wide as eyes, seen from side; anterior ocellus but little behind midpoint between antennal bases and posterior edge of vertex. 23

23(22). Anterior part of scutum much more finely and closely punctate than posterior part; length nearly 5 mm. ..... *cockerelli*

Anterior part of scutum but little if any more finely punctate than posterior part; larger species. 24

24(23). Clypeus short, strongly convex, its apical margin with emargination about one-half as broad as basal width of clypeus; supraclypeal area distinctly more finely punctate than adjacent parts of face. ..... *floridana*

Clypeus longer, less strongly convex, its apical margin with emargination over half as broad as basal width of clypeus; supraclypeal area not distinctly more finely punctate than rest of face. ..... *gillettei*

25(14). Median teeth of sixth tergite long, not greatly widened basally, over twice as long as broad. 26

Median teeth of sixth tergite short, not twice as long as basal width, usually much shorter. 28

26(25). Clypeus more coarsely punctate than vertex. ..... *digiticauda*
Clypeus much more finely punctate than vertex. 27

27(26). Tergites and mesepisterna usually considerably more finely punctate than scutum; body finely punctate; tarsi reddish brown, in contrast to rest of legs. ..... *rufitarsis*

Tergites and mesepisterna nearly as coarsely punctate as scutum; body coarsely punctate; tarsi hardly paler than rest of legs. ..... *sonora*

28(25). Cheeks distinctly less than half as wide as eyes, seen from side..... *microsoma*
Cheeks more than half as wide as eyes, seen from side. 29

29(28). Clypeus dull, finely and closely punctate compared to adjacent parts of face. 30

Clypeus rather coarsely punctate, punctures not much if any finer than those of rest of face. 31

30(29). Abdomen black. ..... *schwarzi* and *prosopidis*
Abdomen largely red. ..... *rufiventris*
31(29). Scutum more finely punctate than vertex. 32
Scutum slightly more coarsely punctate than vertex. ..... *bequaerti*
32(31). Abdomen black. 33
Abdomen red basally. ..... *curriei basalis*
33(32). More densely pubescent; tegulae testaceous. ..... *curriei echinocerei*
Less densely pubescent; tegulae black. ..... *curriei curriei*

Ashmeadiella (Ashmeadiella) curriei curriei Titus

Ashmeadiella curriei Titus, 1904, Proc. Ent. Soc. Wash., **6**:100, ♀; Michener, 1936, Am. Mus. Nov., **875**:7, ♂.

Heriades prosopidis Cockerell, 1897, Ann. Mag. Nat. Hist., (6)**20**:140, ♂, nec ♀.
Ashmeadiella basalis nigra Michener, 1936, Am. Mus. Nov., **875**:7, ♀♂.

This is a small black species. It is easily recognized in the female by the finely punctate and entirely dull anterior margin of the clypeus. Although exhibited also by *femorata*, the distinctly convex antero-lateral margins of the clypeus are quite distinctive. The tegulae are punctate in nearly all specimens of *curriei*, while in most of the other species the central and posterior parts of the tegulae are impunctate or nearly so.

Female: Inner margins of eyes converging toward clypeus, except for lower parts which diverge; facial line somewhat shorter than transfacial; flagellum brown beneath; truncation of clypeus slightly concave, shorter than distance from end of truncation to eye margin; ends of truncation not strongly marked; margin of clypeus between ends of truncation and lateral angles of clypeus convex; basal two-thirds of clypeus rather coarsely punctate, but apical part finely and closely punctate, margin not smooth or impunctate; mandibles with dorsal carina of outer side ending slightly nearer anterior than posterior basal angle of mandible; distance from first to third mandibular tooth much less than width of eye, about equal to length of last two antennal segments; cheeks a little more than half as wide as eyes, seen from side; anterior ocellus nearly twice as far from antennal sockets as from posterior edge of vertex; distance between posterior ocelli equal to or only slightly greater than distance to eye, and distinctly greater than distance to posterior edge of vertex; vertex and frons rather coarsely punctate; supraclypeal area more finely so. Scutum more finely punctate than vertex, with narrow margin of whitish pubescence, no pair of pubescent spots anteriorly; tegulae black or nearly so, with punctures, especially near outer margin; mesepisterna as coarsely or nearly as coarsely punctate as vertex; wings faintly dusky; inner margin of inner hind tibial spurs finely serrate with about fifteen small teeth, outer margin with eleven larger teeth; inner margin of outer hind tibial spurs practically toothless, outer margin with six, moderate sized, oblique teeth. Abdominal tergites more finely punctate than scutum; tergites one to four with narrow, apical bands of white pubescence; fifth tergite with a less conspicuous apical pubescent band, or without such a band; scopa white. Length 5 to 6½ mm.

Male: Similar to female except as indicated below: upper two-thirds of inner margins of eyes slightly converging toward clypeus; flagellum dusky or brown beneath; anterior margin of clypeus with inconspicuous, shallow emar-

gination about half as broad as basal width of clypeus; anterior part of clypeus with narrow, finely and closely punctate band just basad to the shiny margin; cheeks narrower than eyes seen from side; vertex coarsely and not closely punctate. Scutum more finely punctate than vertex; mesepisterna punctured like scutum; inner margin of inner hind tibial spurs with about thirteen small teeth, outer margin with about four rather large, oblique teeth; median teeth of sixth tergite variable, slightly longer than broad, subparallel sided, emargination between them variable in shape. Length 4 to 5 mm.

This widely distributed but rather rare species is quite variable, and its relationship to the form known as *echinocerei* is not entirely evident. The latter is perhaps a desert subspecies of *curriei*, but the occurrence of *curriei* in the desert may indicate that it is a synonym instead of a subspecies. Just which specimens are to be placed in *echinocerei* and which in *curriei* cannot be decided until more specimens of true *echinocerei* come to hand.

Typical *curriei* occurs from British Columbia to California and Colorado. California records are from the northern part of the state and from the eastern side of the Sierra Nevada. Several specimens from desert regions recorded below should possibly be discussed under *echinocerei*.

WASHINGTON: White Rock Springs, Stevens Pass, Cascade Mountains, July 13, 1930 (E. C. Van Dyke). OREGON: Mount Hood, 3000 to 6000 feet, August 6, 1925 (C. L. Fox). CALIFORNIA: Mount Lassen, 6700 feet, July 21 and 22, 1937 (F. X. Williams); Big Flat, Trinity County, June 20, 1934 (G. E. Bohart); Mammoth, Mono County, July 21, 1936 (G. E. & R. M. Bohart); Bishop Creek, Inyo County, 8000 feet, on *Nama rothrockii*, June 22, 1937 (C. D. Michener). UTAH: Zion Canyon, June 19, 1933 (O. H. Swezey). COLORADO: Florissant, June 19 (T. D. A. Cockerell); Boulder, May 26, 1908 (S. A. Rohwer).

A specimen from Las Vegas, NEW MEXICO, and one from Mazourka Canyon, Inyo Mountains, Inyo County, California, May 25, 1937 (C. D. Michener) are rather densely pubescent for typical *curriei*. A female specimen from Lone Pine Canyon, Inyo County, California, 8000 feet elevation, on *Cryptantha* (C. D. Michener) is hardly 5 mm. long. A male from the same locality is approximately the same size. A female from Dos Palmos, Riverside County, California, March 28, 1934, appears to have been wet, and may have been more densely pubescent than is now apparent. It exhibits an unusually strong contrast in punctation between the vertex and the scutum. A large female, 6 mm. long, from San Bernardo, SONORA, Mexico, July 10, 1935, is in poor condition, practically all the pubescence being worn off. It is rather coarsely punctate, and shows very little contrast in punctation between the vertex and the scutum. A male from the same locality, June 29, 1935, is not peculiarly punctured.

Type: Female; from Kaslo, British Columbia, in United States National Museum.

Ashmeadiella (Ashmeadiella) curriei echinocerei (Cockerell)

Ashmeadiella echinocerei Cockerell, 1911, Can. Ent., **43**:132, ♀; Cockerell, 1924, Proc. Calif. Acad. Sci. (4)**12**:555, ♀; Michener, 1936, Am. Mus. Novit., **875**:6, ♀.

Ashmeadiella echinocacti Cockerell (laps. cal.), 1931, Ann. Mag. Nat. Hist. (8)**10**:543.

Female: Similar to typical *curriei* but pubescence abundant, abdominal

bands broad; tegulae piceous or testaceous. The scutum is distinctly more finely punctate than the vertex, and the abdomen is finely punctate.

A further discussion of the relationships of this form will be found under *curriei*.

ARIZONA: Prescott, July 27, 1932, on *Opuntia* (P. H. Timberlake).

A specimen previously recorded by Cockerell from Puerto Refugio, Angel de la Guardia Island, Gulf of California, May 1, 1921 (E. P. Van Duzee) appears to be the present subspecies.

Type: female; from Flagstaff, ARIZONA, in United States National Museum.

Ashmeadiella (Ashmeadiella) curriei basalis (Michener)

Ashmeadiella basalis basalis Michener, 1936, Am. Mus. Nov., **875**:6, ♂ ♀.

Female: Similar to *curriei curriei* but tegulae testaceous; hind femora red apically; inner side of hind tibiae red; first tergite red, second and third red laterally, or rarely second and third entirely red and fourth and fifth red laterally.

Male: Similar to female but red of hind legs restricted to bases of hind femora; red of tergites usually restricted to sides of tergites one and two, rarely second entirely black, and rarely second and third largely red. Truncation of clypeus broader than in typical *curriei*.

This form is found in California west of the deserts at least as far north as Napa County. Its occurrence in the Clark Mountains is surprising, especially since some specimens from there have an unusually large amount of red. A black form would be expected there.

CALIFORNIA: Wing Canyon, Napa County, 950 feet elevation, August 10, 1935 (P. H. Baldwin); San Rafael (F. X. Williams); Searsville Lake, near Stanford University, August 2, 1937 (F. X. Williams); Clark Mountains, July 7 and 8, 1938, 4000 feet elevation on *Baileya multiradiata*, 6500 feet on *Salvia;* Coffee Camp, June 8, 1925, on *Phacelia;* Lone Pine Canyon, San Gabriel Mountains, July 21, 1936; Big Pines Camp, July 13, 1927, on *Phacelia ramossima, Cordylanthus nevinii*, and *Mimulus;* Cajon Valley, July 4, 1933; Big Bear Valley, July 7, 1934, on *Phacelia heterophylla;* Riverside, March 19 to May 28, on *Lotus subscaber* and *scoparius, Phacelia ramosissima, Hugelia virgata, Encelia farinosa;* Hidden Lake, San Jacinto Mountains, July 23, 1928, on *Lotus nevadensis* (all collected by P. H. Timberlake); Idyllwild, June 25, 1928 (E. C. Van Dyke), July 14, 1912, and July 22, 1933, on *Lotus argophyllus* (P. H. Timberlake).

Type: male; Altadena, California, in the American Museum of Natural History.

Ashmeadiella (Ashmeadiella) bucconis bucconis (Say)

Osmia bucconis Say, 1837, Bost. Jour. Nat. Hist., **1**:400, ♀ ♂; LeConte, 1859, Compl. Writ. Say, **2**:777, ♀ ♂; Cresson, 1864, Proc. Ent. Soc. Phila., **3**:26, ♀ ♂.

Heriades bucconis Robertson, 1897, Trans. Acad. Sci. St. Louis, **7**:347, ♀; Robertson, 1902, Ent. News, **13**:79.

Eriades bucconis Friese, 1911, Das Tierreich, **28**:29, ♀ ♂.

Ashmeadiella bucconis Robertson, 1900, Trans. Acad. Sci. St. Louis, **10**:52; Robertson, 1902, Trans. Am. Ent. Soc., **29**:171; Cockerell, 1908, Entom., **41**:61; Robertson, 1914, Ent. News, **25**:70; Michener, 1936, Am. Mus. Nov., **875**:4, ♀ ♂.

Ashmeadiella denticulata Graenicher (misidentification), 1935, Ann. Ent. Soc. Am., **28**:304.

Megachile osmioides Cresson, 1872, Trans. Am. Ent. Soc., **4**:269, ♀ ♂; Cresson, 1916, Mem. Am. Ent. Soc., **1**:126, ♀.

Heriades osmioides Cresson, 1878, Trans. Am. Ent. Soc., **7**:221, ♀; Schletterer, 1889, Zool. Jahrb., Abt. f. Syst., Geog. u. Biol., **4**:684; Cockerell, 1897, Ann. Mag. Nat. Hist., (6)**20**:141.

Eriades osmioides Dalla Torre, 1896, Cat. Hymen., **10**:379.

This is a large, elongate, sparsely pubescent, coarsely punctate, black species, with greatly developed cheeks and posterior part of vertex.

Female: Under side of flagellum usually brownish; supraclypeal area sparsely punctate; clypeus coarsely and closely punctate, except for finely and closely punctate, narrow, subapical region and narrow, smooth margin of apical truncation, in which a pair of inconspicuous notches are usually present; clypeal truncation slightly shorter than distance from end of truncation to lateral angle of clypeus; distance between first and third mandibular tooth but little less than greatest width of eye, and a little greater than length of last three flagellar segments; upper carina of apical margin of mandibles ending basally about equidistant between anterior and posterior basal angles of mandibles; cheeks slightly broader than eyes, more coarsely punctate than mesepisterna; anterior ocellus about half as far from antennal sockets as from posterior edge of vertex; distance between posterior ocelli but little less than distance to nearest eye margin, less than half distance to posterior edge of vertex; vertex coarsely punctate, with small smooth area behind ocelli. Scutum closely punctate and slightly more finely so than vertex, without spots of pubescence anteriorly; mesepisterna distinctly more finely punctate than scutum; wings faintly dusky; margins of hind tibial spurs finely serrate. Abdomen strongly punctate, more finely so than scutum; tergites one to four with apical bands of white pubescence; scopa brownish yellow. Length 7 to 10 mm.

Male: Differs from the description of the female thus: clypeus and lower sides of face finely punctate, in contrast to supraclypeal area and frons, which are coarsely so; apex of clypeus with a weak median emargination, about three-fourths as wide as basal width of clypeus; anterior margin of clypeus somewhat produced into broad, rounded, shiny lobe on each side; cheeks often about as coarsely punctate as, but less closely punctate than mesepisterna; median teeth of sixth tergite subtruncated, subparallel sided, hardly longer than wide, emargination between them broader than a semicircle. Length 6 to 8 mm.

This form is found from Wisconsin, Indiana and Louisiana west to Texas and North Dakota. In the western part of its range, typical *bucconis* grades into *denticulata*, so that many specimens from Texas, New Mexico, and North Dakota can be placed in one form or the other only arbitrarily.

ILLINOIS: Arenzville, August 14, 1913; Meredosia, August 17, 1913, on sand (from collection of Illinois Natural History Survey). LOUISIANA: Logansport, May 30, 1905 (U. S. N. M.) NEBRASKA: Nebraska City, Sept. 16, 1901, on *Solidago* (M. A. Carriker, Jr.); West Point, on *Solidago*, August 20, 1903 (J. C. Crawford). KANSAS: Barton County, 1816 feet elevation (S. J. Hunter); Clark County, June (F. H. Snow); Pratt County, 1900 feet elevation, June 27, 1911 (F. X. Williams); Phillips

County, 1940 feet elevation, August 30, 1912 (F. X. Williams); Norton County, 2270 feet elevation, August 24, 1912 (F. X. Williams) (all from University of Kansas collection); Baldwin (J. C. Bridewell, U. S. N. M.) TEXAS: Austin (A. L. Melander, Washington State College); Paris, May 24, 1904 (F. C. Bishopp); Kerrville, on *Tetragonotheca ludovicinia*, April 12, 1907 (F. C. Pratt); Denton, on *Gaillardia pulchella* (F. C. Bishopp); New Boston, June 5, 1909 (F. C. Pratt); Sabinal, May 28, 1910 (F. C. Pratt); Grand Prairie, June, 1905, on *Ambrosia psilostachya* (C. R. Jones); Rosson, June 7, 1905 (F. C. Bishopp); Richardson, June 17, 1913 (F. C. Bishopp) (all from U. S. N. M.)

A specimen from Timnath, Colorado, August 16, 1906 (U. S. N. M.) resembles typical *bucconis* except that the punctures of the cheeks are finer than those of the mesepisterna. The specimens recorded below from North Dakota have the punctures of the cheeks similar to, or slightly smaller than, those of the mesepisterna, the scopa pale as in *denticulata*, but the median ocellus in some individuals far foreward, nearly as in *bucconis*. It is difficult to determine the form to which they should be assigned.

NORTH DAKOTA: Mott, July 7, 1918, on *Brauneria pallida;* Williston, August 9 and 15, 1915, on *Grindelia squarrosa;* Graniville, August 2, 1915, on *Grindelia squarrosa;* Carbia, August 12, 1935, on *Grindelia squarrosa;* Minot, August 22, 1915, on *Grindelia squarrosa;* Fargo, August 11, 1917, on *Grindelia squarrosa;* Kathryn, July 16, 1913, on *Lactuca pulchella* (all collected by Prof. O. A. Stevens).

A male specimen from Dallas, Texas, May 18, 1905 (F. C. Bishopp, U. S. N. M.) and a male from Quinlan, Texas, May 7, 1904 (F. C. Bishopp, U. S. N. M.) have the median ocellus placed as in *denticulata*, but the cheeks are as coarsely and closely punctate as the mesepisternum.

Type: Indiana, destroyed.

Ashmeadiella (Ashmeadiella) bucconis denticulata (Cresson)

Heriades ? denticulatum Cresson, 1878, Trans. Am. Ent. Soc., **7**:108, ♂; Cresson, 1916, Mem. Am. Ent. Soc., **1**:117, ♂.

Heriades denticulata Schletterer, 1889, Zool. Jahrb., Abt. f. Syst., Geog. u. Biol., **4**:659, 687, ♂; Robertson, 1897, Trans. Acad. Sci. St. Louis, **7**:347 (=bucconis).

Eriades denticulatus Dalla Torre, 1896, Cat. Hymen., **10**:375, ♂.

Ashmeadiella denticulata Cockerell, 1908, Entom., **41**:61; Cockerell, 1910, Univ. Colo. Stud., **7**:191; Michener, 1936, Am. Mus. Nov., **875**:5.

Heriades ? rotundiceps Cresson, 1879, Trans. Am. Ent. Soc., **7**:205, ♀; Cresson, 1916, Mem. Am. Ent. Soc., **1**:129, ♀.

Heriades rotundiceps Schletterer, 1889, Zool. Jahrb., Abt. f. Syst., Geog. u. Biol., **4**:687, ♀.

Eriades rotundiceps Friese, 1911, Das Tierreich, **28**:25, ♀.

Ashmeadiella wislizeni Cockerell, 1922, Ann. Mag. Nat. Hist., (9)**10**:545, ♂; Cockerell, 1931, Ann. Mag. Nat. Hist., (10)**8**:543 (key).

Ashmeadiella bucconis Cockerell (misidentification), 1898, Zool., **2**(4):311; Cockerell, 1898, Bull. Denison Univ., **11**:64, 73; Cockerell, 1898, Bull. Univ. New Mex., **1**:64, 73; Cockerell, 1902, Ann. Mag. Nat. Hist., **7**(7):129, ♀; Cockerell and Atkins, 1902, Ann. Mag. Nat. Hist., (7)**9**:233; Viereck, 1903, Trans. Am. Ent. Soc. **29**:46 (record).

Female: Similar to typical *bucconis*. Anterior ocellus but little anterior to midpoint between bases of antennae and posterior edge of vertex; vertex without smooth area behind ocelli; cheeks often slightly narrower than eyes, seen from side, its punctures finer than those of mesepisterna; punctation finer than that of *bucconis bucconis;* scopa dull white. Length 7 to 8 mm.

Male: Differs from *bucconis bucconis* in having anterior ocellus but little anterior to midpoint between antennal bases and posterior margin of vertex; cheeks distinctly narrower than eyes, seen from side, its punctures smaller than those of mesepisterna; punctation finer than that of *bucconis bucconis*. Length 5½ to 7 mm.

This subspecies is widely distributed over western North America.

MONTANA: (No locality, Acad. Nat. Sci. Phila.) COLORADO: Manitou, July 21, 1897 (Acad. Nat. Sci. Phila.); Pueblo, August 9, 1920, 4700 feet elevation, (Am. Mus. Nat. Hist.); Meeker, July 20 to 21, 1919, 6200 feet elevation (Am. Mus. Nat. Hist.); Rifle, July 3, 1905 (S. A. Rohwer); Fort Collins, June 19, 1900 (U. S. N. M.) NEW MEXICO: Mesilla, May 4, 1909 (C. N. Ainslie); High Rolls, June 11, 1902 (Acad. Nat. Sci. Phila.) TEXAS: Presidio County, July 16, 1927 (R. H. Beamer, Univ. of Kansas). ARIZONA: Williams, 6750 feet elevation, June 23, 1931 (H. A. Scullen); Tucson (F. M. Carpenter, Mus. Comp. Zool.); Yuma, June, 1937 (R. C. Dickson). IDAHO: Lewiston, July 14 to 19, 1925 (C. L. Fox, Cal. Acad. Sci.) BRITISH COLUMBIA: Keremeos, July 19, 1910; Vernon, July 11, 1914 (F. W. L. Sladen); Walhachin, July 21, 1919 (E. R. Buckell); Spillimacheen, July 13, 1914 (F. W. L. Sladen); Summerland, July 9, 1916 (F. W. L. Sladen) (all from Canadian National Collection). Specimens from the last two localities have some characteristics of typical *bucconis*. WASHINGTON: Yakima, July 20, 1918 (A. L. Melander); Wenatchee, July 26, 1906. OREGON: Ashland, August 2, 1918 (E. P. VanDuzee, Cal. Acad. Sci.); 25 miles east of Prineville, 3600 feet elevation, July 13, 1936 (H. A. Scullen); Prineville, 3150 feet elevation, on *Chrysothamnus*, August 12, 1929 (H. A. Scullen); Cove, Union County, July 18, 1936 (G. Ferguson); Grande Ronde River, near Imbler, Union County, July 19, 1936 (G. Ferguson). CALIFORNIA: Campo, August 10, 1935 (E. I. Beamer); Palmdale, August 1, 1935 (Jean Russel) (both from University of Kansas collection); Buck Creek, Modoc County, July 21 and 25, 1922 (C. L. Fox); Mill Creek Canyon, San Bernardino Mountains, September 24, 1923 (E. P. Van Duzee); Davis Creek, Modoc County, July 13, 1922 (C. L. Fox); Cayton, Shasta County, July 13, 1918 (E. P. Van Duzee); Bishop, Inyo County, June 20, 1928 (E. P. VanDuzee); Idyllwild, July 7, 1928 (E. C. VanDyke); Lassen Creek, Modoc County, July 22, 1922 (C. L. Fox); Big Pine, Inyo County, July 17 to 20, 1929 (E. P. VanDuzee); Jacumba, October 3, 1925 (J. D. Gunder); Lake City, Modoc County, July 31, 1922 (C. L. Fox); Mokelumne Hill, Calaveras County, July 28, 1931 (F. E. Blaisdell) (all in collection of California Academy of Sciences); Mammoth, July 24, 1933 (G. E. & R. M. Bohart); Redlands, May 15, 1936, on *Encelia farinosa* (C. D. Michener); Mariposa, June 13, 1938; Kaweah, June, 1936 (F. T. Scott); Clark Mountains, 4000 feet, July 2, 1938, on *Baileya multiradiata;* twenty miles west of Twenty-nine Palms, on same flower; four miles north of Warmers Well, Mojave Desert, October 22, 1927, on *Ericameria teretifolia;* Coffee Camp, June 25, 1929, on *Senecio douglasii;* Big Pines Camp, June 17, 1927, on *Erigeron stenophyllus;* Vivian Creek Trail, San Bernardino Mountains, July 21, 1935, on *Erigeron stenophyllus;* Riverside, May 17 to November 14, on *Gutierrezia californica, Erigeron stenophyllus, Senecio douglasii, Heterotheca grandiflora, Encelia farinosa, Chaenactis glabriuscula, Solidago californica, Coreopsis lanceolata;* Hinkley, October 7, 1928, on *Isocoma acradenia;* the Gavilan, 2200 feet, May 15, 1930, hiding in yucca stem; Santa Ana Mountains, above Elsinore, April 18, 1934, on *Cryptantha intermedia;* Yerba Linda, August 14, 1920, on *Grindelia;* Puente Hills, July 31, 1927, on *Encelia californica* (all P. H. Timberlake collector).

Specimens from Las Vegas, New Mexico are large and have the ocelli placed as in *bucconis bucconis*. Otherwise their characteristics are those of *denticulata*.

Type: male; from Colorado, in the collection of the Academy of Natural Sciences of Philadelphia.

Ashmeadiella (Ashmeadiella) maxima Michener

Ashmeadiella maxima Michener, 1936, Pan-Pac. Ent., **12**:61, ♀ ♂; Michener, 1936, Am. Mus. Nov., **875**:12, 15 (key).

This is a large, robust, black species, with rather abundant pubescence. The male may be confused with *opuntiae*, but differs by the broader face, and the somewhat more widely separated posterior ocelli, as compared to the distance from one of them to the posterior edge of vertex.

Female: Inner margins of eyes converging toward clypeus; under side of flagellum brown; punctation of head rather coarse, punctures separated by a little smooth surface; face broad, greatest distance between eyes equal to length of an eye; punctures of clypeus, except for the impunctate anterior margin and the finely and closely punctate area adjacent to this margin, larger than those of vertex; punctures between ocelli and on lower part of frons and upper part of supraclypeal area finer and closer than those of vertex posterior to ocelli; truncation of clypeus somewhat concave medially, its lateral angles rounded, its length slightly less than distance from end of truncation to lateral angle of clypeus; distance between first and third mandibular teeth much less than width of eye, slightly less than length of last three antennal segments together; anterior ocellus about at the midpoint between bases of antennae and posterior margin of vertex; distance between posterior ocelli about equal to distance to nearest eye margin, less than distance to posterior margin of vertex; cheeks considerably narrower than eyes, seen from side. Punctation of scutum like that of vertex; scutum with pair of pubescent spots anteriorly; mesepisterna, especially below, a little more coarsely punctate than scutum, with a few minute punctures among the larger ones; tegulae and apical segment of each tarsus brown or nearly black; margins of hind tibial spurs finely serrate, inner margin of inner spurs more finely so than others, teeth of outer spurs somewhat oblique. Punctures of abdomen rather coarse and close, especially on sides and on posterior tergites; tergites one to five with apical pubescent bands. Length 7½ to 9 mm.

Male: Similar to female except as indicated: greatest distance between eyes slightly less than length of an eye; clypeus finely and closely punctate, except for smooth apical margin; apex of clypeus with emargination about three-fourths as wide as basal width of clypeus, and demarked by evident but rounded angles; face except for clypeus largely covered with white pubescence; lateral teeth of sixth tergite rather large and acutely pointed, median teeth quite long, broadened basally, nearly parallel sided apically, concavity between them much longer than semicircle. Length nearly 8 mm.

TEXAS: Range, August 11, 1904, on *Opuntia* (J. C. Crawford); Sabinal, June 16 and 18, 1910 (F. C. Pratt); Laredo, October 21, 1908 (Mitchell and Bishopp); Kerville, April 11, 1909, on *Salvia pitcheri* (F. C. Pratt) (all from U. S. N. M.); Pecos High Bridge (Pilsbry) (Acad. Nat. Sci. Phila.)

Type: Female; Devils River, Texas, in the collection of Prof. T. D. A. Cockerell at the University of Colorado, Boulder, Colorado.

Ashmeadiella (Ashmeadiella) occipitalis sp. nov.

This large, robust, black species is easily recognized in both sexes by the polished and sparsely punctate vertex. Other species having a similar appearance such as *maxima* and *opuntiae,* have the median teeth of the sixth tergite of the male long. In the present species these teeth are but little longer than broad.

Female: Inner margins of eyes converging toward clypeus; transfacial line a little longer than facial; flagellum dusky beneath; sides of face densely covered with pubescence; truncation of clypeus slightly concave, as long as distance from end of truncation to lateral angle of clypeus; punctures of anterior edge of clypeus, just basad to the rather broad impunctate margin, fine and close; mandibles with dorsal carina of anterior margin ending somewhat nearer to anterior than to posterior basal angle of mandible; distance from first to third tooth of mandible somewhat shorter than width of eye, nearly as long as last three antennal segments together; cheeks as wide as eyes seen from side, distinctly more finely punctate than vertex; anterior ocellus a little anterior to midpoint between antennal sockets and edge of vertex; distance from posterior ocellus to edge of vertex considerably greater than to eye, the latter distance a little greater than distance between ocelli; punctures of head and thorax, except for propodeum and anterior part of clypeus, coarse and separated by shiny ground; vertex behind ocelli with broad, shiny area with few punctures; scutum with pair of pubescent spots anteriorly; scutum somewhat more coarsely punctate than vertex, disc, except for median line, more sparsely punctate than elsewhere, the punctures being often separated by more than their diameters; punctures of mesepisterna about same size as those of vertex; punctures of scutellum finer than those of scutum and much sparser; wings clear; inner margin of inner hind tibial spurs with about fifteen small teeth, outer margin with about ten large teeth; inner margin of outer hind tibial spurs with about six small, rather oblique, teeth, outer margin with about nine smaller, oblique teeth. Punctures of dorsum of first four abdominal tergites a little finer than those of scutellum, those of elevated portions of tergites separated by more than their diameters; punctures of sides of tergites and of fifth and sixth tergites as coarse as those of scutum and close together; tergites with white apical bands of pubescence, that of fifth tergite weak; sixth tergite slightly pruinose; scopa dull white; sixth sternite produced laterally as a lamella on each side. Length a little over 9 mm.

Male: Transfacial line distinctly longer than facial; under side of flagellum dusky; eyes converging below; apical margin of clypeus with slight concavity considerably shorter than basal width of clypeus; cheeks about half as wide as eyes seen from side; anterior ocellus about midway between antennal bases and posterior edge of vertex; distance between posterior ocelli less than distance to eye, which distance is less than distance to posterior edge of vertex; punctation similar to that of female but a little finer, punctures of cheeks and mesepisterna more nearly the same size; scutellum a little more finely and closely punctate than scutum; abdomen, especially laterally and posteriorly, more finely punctate than in female; raised portion of dorsum of second ter-

gite with punctures separated by their diameters, punctures of first, fourth, fifth, and sixth tergites closer; lateral teeth of sixth tergite rather large and acutely pointed; median teeth dusky, obliquely truncated, a little broader than long, concavity between them a semicircle. Apical segment of each tarsus rufescent; inner margin of inner hind tibial spur finely serrate with about twenty teeth, those of basal part being longer than basal width, outer margin with about twelve teeth, the basal three and apical few of which are small; inner margin of outer hind tibial spur with about five, rather oblique teeth, outer margin with about nine, rather small teeth; tegulae faintly rufescent. Pubescence as in female but much more abundant on face; no apical band of pubescence on fifth tergite. Length 7 to 8 mm.

Holotype female (Calif. Acad. Sci., Ent. No. 4726), allotype male (Calif. Acad. Sci., Ent. No. 4727) and a paratype of each sex from Sabino Canyon, Santa Catalina Mountains, Arizona, August 13, 1924 (E. P. VanDuzee). Paratypes, all from ARIZONA: two females, Sonorita, August 5, 1924 (J. O. Martin, E. P. VanDuzee); one female, Baboquivari Mountains, August 18, 1924 (O. C. Poling); two females, Pepper Sauce Canyon, Santa Catalina Mountains, August 15, 1924 (E. P. VanDuzee). Two paratypes are in the author's collection, the rest in the collection of the California Academy of Sciences. An additional specimen of this species is from El Paso, Texas, April 6, 1902 (Acad. Nat. Sci. Phila.)

Ashmeadiella (Ashmeadiella) femorata (Michener)

Osmia femorata Michener, 1936, Bull. So. Calif. Acad. Sci., **35**:91, ♀.

This is a rather small, robust, not densely pubescent species. It is black, except for the hind femora and inner sides of the hind tibiae, which are red. The posterior legs are unusually robust in both sexes. This species is superficially similar to the group of *bigeloviae,* but differs from these as well as from all other known species except *titusi* by the large teeth of the outer margin of the inner hind tibial spurs.

Female: Inner margins of eyes converging below; transfacial line considerably longer than facial line; under side of flagellum brown; head closely and rather finely punctured except for the smooth apical margin of clypeus; clypeus with distinctly concave apical truncation (similar to but slightly shallower than that of *dimalla*) nearly as long as distance from end of truncation to lateral angle of clypeus, often reddish, margin of clypeus between these two points convex; distance from first to third mandibular tooth less than width of eye or length of last three antennal segments; mandibles reddish subapically; punctures of clypeus a little larger and perhaps closer than those of vertex, those of cheeks finer than those of vertex; cheeks narrower than eyes seen from side; anterior ocellus posterior to midpoint between bases of antennae and posterior edge of vertex; distance between posterior ocelli slightly greater than or equal to distance to nearest eye margin or to posterior edge of vertex. Scutum without pair of pubescent spots anteriorly; punctures of scutum and

scutellum larger than or as large as, those of vertex, and separated by a little shiny surface; mesepisterna similarly or a little more finely punctured; wings slightly dusky; tegulae dark testaceous; posterior tibiae except outer sides and posterior femora red; hind tibial spurs robust, black, strongly curved apically, inner margin of inner spurs with about seven rather large teeth, outer margin with about seven very large teeth; inner margin of outer spurs with about two rather large teeth, outer margin with about three rather large teeth. Abdomen with strong punctures, those of dorsum of second tergite separated by about their diameters; punctures of fourth to sixth tergites, and of sides of all tergites, close; tergites one to five with apical bands of white pubescence, and with apical margins testaceous; scopa white. Length 5½ to 7 mm.

Male: Similar to female. Face, especially clypeus, densely covered with pubescence; clypeus with distinct apical concavity less than half as broad as basal width of clypeus and demarked by evident angles; punctures of upper parts of mesepisterna widely sparated; small segments of tarsi rufescent; inner margin of inner hind tibial spurs with about eight small teeth, all on basal half of spurs, outer margin with two large teeth medially, a small one distad to them and about two small ones basad to them; outer spur with about four oblique teeth on each margin. Abdomen with punctures coarser than in female, though not as coarse as those of scutum; outer teeth of sixth tergite acutely pointed, longer than wide; median teeth nearly parallel sided apically, nearly twice as long as broad, broadened basally, concavity between them longer than a semicircle. Length 5 to 5½ mm.

In many females the punctures of the abdomen are coarser than described, more as in the male. The male of this species is here described for the first time.

This species occurs in the deserts of southern California, north as far as Inyo County.

CALIFORNIA: Mazourka Canyon, Inyo Mountains, Inyo County, May 25, 1937, on *Parosela fremontii* (C. D. Michener); six miles south of Olancha, Inyo County, June 20, 1937 (E. Gehrhardt); Andrade, Imperial County, March 6, on *Larrea* (T. D. A. Cockerell); Dos Palmos, Riverside County, March 19, 1934 and March 28, 1934 (from Cazier and Bohart); Cathedral City, Riverside County, April 10, 1936, on *Larrea glutinosa* (C. D. Michener); Taquitz Canyon, Riverside County, April 16, 1938, on *Larrea glutinosa* (G. E. and R. M. Bohart); Palm Canyon, April 5, 1925, on same flower; two mile south of Oasis, March 8, 1936, on same flower, and April 19, 1925, on *Cercidium torreyanum;* La Quinta, March 2 and 17, 1934, on *Larrea glutinosa* and March 4, 1936, on *Hyptis emoryi;* Box Canyon, April 13, 1934, on *Cercidium torreyanum;* Painted Canyon, April 18, 1925, on same flower (All P. H. Timberlake).

Type: female; from ten miles east of Borego Valley, California, on loan deposit at the California Academy of Sciences.

The discovery of the male and of reliable generic characters in the females shows clearly that *femorata* is an *Ashmeadiella,* not an *Osmia* as originally described.

Ashmeadiella (Ashmeadiella) titusi sp. nov.

This species is closely related to *femorata*, from which it differs by the light rufotestaceous tegulae, the red middle as well as hind femora, the slightly coarser punctation, and the feebly concave clypeal emargination in the female. The distribution of the two species appears also to be different, *titusi* occurring west of the southern California mountains, *femorata* in the deserts east of them. These are the only species in which the hind tibial spurs are robust, curved, and very coarsely toothed.

Female: Inner margins of eyes slightly converging below; facial line shorter than transfacial; under side of flagellum dark brown; punctures of head close and rather fine, those of clypeus and supraclypeal area slightly coarser than those of rest of head; clypeal truncation slightly concave, demarked by rather distinct angles, shorter than distance from its ends to eye margin, margin between these two points somewhat convex, margin of truncation shining and impunctate, although somewhat longitudinally wrinkled; mandibles with reddish subapical band, distance from first to third tooth much less than greatest breadth of eye, nearly as great as length of last three antennal segments together; cheeks nearly as wide as eyes seen from side, more finely punctate than vertex; anterior ocellus behind midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli about equal to distance to posterior edge of vertex and to eye. Scutum without pair of pubescent spots anteriorly, its punctures, especially posteriorly, distinctly larger than those of vertex and separated by shiny surface; mesepisterna with punctation similar to but slightly sparser than that of scutum; wings slightly dusky; tegulae light rufotestaceous; middle and hind femora red, hind tibiae red except on outer side; hind metatarsi red on inner side, and reddish outside, especially basally (one paratype has fore femora and inner sides of fore and middle tibiae also partly reddish); hind tibial spurs robust, red, strongly curved apically; inner margin of inner hind tibial spurs with about six large teeth, outer margin with about six teeth, the first rather small, others very large and long; inner margin of outer spur with about two rather large teeth, outer margin with about four oblique teeth. Abdominal tergites rather strongly punctate, punctures even on dorsum of second tergite separated by a little less than their diameters; tergites one to five with apical bands of white pubescence and with apical margins rufotestaceous. Length 5½ mm. (paratypes varying from 5 to 6 mm.)

Male: Similar to female; clypeus with shallow apical emargination, about one-half as long as basal width of clypeus, demarked by distinct angles; punctures of clypeus and supraclypeal area slightly finer than those of vertex; cheeks distinctly narrower than eyes, seen from side. Mesepisternum with punctures finer than those of scutum and rather widely separated; hind tibial spurs apparently similar to those of *femorata*, but red. Abdomen more coarsely punctate than in female; lateral teeth of sixth tergite reddish, longer than broad, acutely angulate; median teeth subparallel sided, nearly twice as broad as long, concavity between them longer than a semicircle. Length nearly 5mm.

Holotype female, Riverside, California, April 30, 1928, on *Lotus scoparius* (P. H. Timberlake). Paratypes: same locality, one on May 22, 1929, on *Phacelia ramosissima*, one on May 24, 1928, on *Lotus scoparius* (P. H. Timberlake). Allotype male, Mill Creek, San Bernardino Mountains, about 2000 feet elevation, on *Helianthus gracilentus* (P. H. Timberlake).

I am entirely indebted to Mr. P. H. Timberlake, who had labeled his specimens with the manuscript name *titusi*, for the opportunity to study this species.

Ashmeadiella (Ashmeadiella) bigeloviae (Cockerell)

Heriades bigeloviae Cockerell, 1897, Ann. Mag. Nat. Hist., (6)**20**:136, ♂ ♀.
Eriades bigeloviae Friese, 1911, Das Tierreich, **28**:29, ♀ ♂.

Ashmeadiella bigeloviae Cockerell, 1898, Bull. Denison Univ., **11**:64 (key); Cockerell, 1898, Bull. Univ. New Mex., **1**:64 (key); Cockerell and Atkins, 1902, Ann. Mag. Nat. Hist., **9**(7):233 (list); Michener, 1936, Pan-Pac. Ent., **12**:58, ♀ ♂; Michener, 1936, Am. Mus. Nov., **875**:12, 14 (key).

This is a rather small, coarsely punctate species, black with the middle and hind legs largely red. The pubescence is not as abundant as in *haematopoda* and *rhodopus*.

Female: Inner margins of eyes converging below; under side of flagellum dusky; punctation of head coarse and close, cheeks more finely punctate than rest of head; clypeus with apical truncation bounded by more distinct angles than in *haematopoda* or *rhodopus*, truncation nearly as broad as distance from end of truncation to lateral angle of clypeus; distance from first to third mandibular tooth less than width of eye or length of last three antennal segments; anterior ocellus posterior to midpoint between bases of antennae and posterior edge of vertex. Scutum with punctures similar to those of vertex but more widely separated; scutum with distinct band of pubescence around it, so that there are no separate spots of pubescence anteriorly; punctures of mesepisterna finer than those of scutum; tegulae testaceous; middle femora and hind femora and tibiae red, fore femora, middle tibiae, and hind metatarsi sometimes reddish in part; inner margin of inner hind tibial spurs with fourteen small teeth, outer margin with about nine large teeth; inner margin of outer spurs with about five large, oblique teeth, outer margin with about seven oblique teeth. Abdomen quite coarsely punctate; posterior margins of tergites reddish. Length 5½ to 6½ mm.

Male: Similar to female. Anterior margin of clypeus with concavity over half as long as basal width of clypeus and demarked by distinct angles; tarsi reddish; inner margin of inner hind tibial spurs with about twelve teeth, outer margin with about eight teeth; lateral teeth of sixth tergite short and acutely pointed, median teeth rather translucent, about as wide as long, rounded, concavity between them wider than a semi-circle. Length 4½ to 5½ mm.

This species occurs in the desert and arid regions of Texas, New Mexico, Arizona and California.

Texas: El Paso, April 5, 1902. New Mexico: Alamogordo, April 17, 1902. Arizona: Florence, May 30, August 10, 1903 (C. R. Biederman); Yuma, April,

1937; Bill Williams Fork, August (F. H. Snow, Univ. of Kansas); Tempe (J. Bequaert, Mus. Comp. Zool.) CALIFORNIA: Lone Pine, Inyo County, May 24, 1937, on *Heliotropium curassavicum* (C. D. Michener); Mazourka Canyon, Inyo Mountains, Inyo County, California, May 25, 1937, on *Parosela fremontii* (C. D. Michener); Hinkley, October 7, 1928, on *Isocoma acradenia;* Riverside, April 19, 1925, on *Gutierrezia californica;* La Quinta, April 7, 1936, on *Cercidium torrevanum* and *Larrea glutinosa;* Oasis, March 27, 1934, on *Cercidium torreyanum;* five miles south of Coachella, March 7, 1936, on *Heliotropium curassavicum;* Box Canyon, April 13, 1934, on *Acacia greggii;* Westmoreland, May 31, 1930, on *Sesuvium sessile* and *Heliotropium curassavicum;* ten miles west of Twenty-nine Palms, April 13, 1935, on *Isomeris arborea* (all P. H. Timberlake); Twenty-nine Palms, August 3, 1933, on *Wislizenia refracta* (P. H. Timberlake), and April 14, 1938 (G. E. and R. M. Bohart); San Felipe Road, San Diego County, April 18, 1934; Shavers Well, Riverside County, April 8, 1934; Dos Palmos, Riverside County, March 19, 1934; Cathedral City, Riverside County, April 10, 1936, on *Cercidium torreyanum* (C. D. Michener); five miles west of Indio, April 10, 1936, on same plant; two miles east on Indio, April 10, 1936, on *Geraea canescens* (C. D. Michener).

Type: male; Las Cruces, New Mexico, in United States National Museum.

Ashmeadiella (Ashmeadiella) haematopoda Cockerell

Ashmeadiella haematopoda Cockerell, 1924, Proc. Calif. Acad. Sci., (4)**12**:555, ♀; Michener, 1936, Pan-Pac. Ent., **12**:58, ♀ ♂; Michener, 1936, Am. Mus. Nov., **875**:12, 14 (key).

This large species is probably the most abundantly pubescent form in the genus. Moreover, the black body, red legs, and broad bands of snowy hair make it a most striking species.

Female: Inner margins of eyes converging below; pubescence covering face except clypeus; flagellum brown beneath; punctation of head rather fine and dense, finer on clypeus than on vertex and frons; clypeus with slightly emarginate truncation, shorter than distance from end of truncation to lateral angle of clypeus, angles at ends of truncation weaker than in *bigeloviae;* mandibles with red subapical band; distance between first and third mandibular teeth less than width of eye and less than length of last three antennal segments together; anterior ocellus posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli greater than distance to nearest eye margin, hardly greater than distance to posterior edge of vertex; cheeks narrower than eyes, seen from side. Scutum with band of pubescence all the way around, with two broad areas in transverse anterior part; punctures of scutum of same size as, or slightly larger than, those of vertex and separated by very little shiny surface; tegulae testaceous; wings clear; mesepisterna punctured about as scutum, perhaps a little more finely so; legs red, coxae usually black; inner margin of inner hind tibial spur finely serrate with about fourteen small teeth; outer margin of inner hind tibial spur with eight to eleven teeth; both margins of outer spur with six or seven oblique teeth. Abdomen rather finely though distinctly punctate; tergites one to five with broad apical bands of white pubescence, scopa dull white. Length 5 to 7 mm.

Male: Similar to female. Face densely covered with white hair; anterior margin of clypeus with weak emargination, distinctly shorter than basal width

of clypeus, and demarked laterally by distinct, rounded angles; pubescent band across anterior margin of scutum broad; inner margin of inner hind tibial spurs minutely and inconspicuously serrate, outer margin and margins of outer spurs with few, inconspicuous, strongly oblique, teeth; lateral teeth of sixth tergite longer than basal width; median teeth over twice as long as basal width, but little widened basally; teeth of sixth tergite usually red. Length 5 to 7 mm.

The number and shape of the teeth of the outer margin of the inner hind tibial spur vary. They are few and low and oblique in specimens from Inyo County, California, although the variation in a single series is great.

This species occurs on the deserts of Sonora and California.

CALIFORNIA: Westmoreland, May 31, 1930, on *Heliotropium curassavicum* and *Parosela emoryi* (P. H. Timberlake), May 15, 1933 (collector unknown); Dos Palmos, March 19, 1934; Edom, April 7, 1936, on *Palafoxia linearis;* west shore of Owens Lake, Inyo County, June 2, 1937, on *Petalonyx thurberi* (C. D. Michener).

Type: female; Fresh Water Bay, Tiburon Island, Gulf of California, in the California Academy of Sciences.

The type is a little more coarsely punctate and smaller than most Californian specimens, but until additional material from Sonora is known, it would not be wise to attempt to distinguish a northern form. At the present time only the type specimen itself is known from south of the Mexican border.

Ashmeadiella (Ashmeadiella) rhodopus Michener

Ashmeadiella rhodopus Michener, 1936, Pan-Pac. Ent., **12**:59, ♂ ♀; Michener, 1936, Am. Mus. Nov., **875**:12, 14 (key).

Ashmeadiella rufipes Cockerell, (misidentification), 1924, Proc. Calif. Acad. Sci., (4)**12**:555.

Female: Similar to *haematopoda* but a little more coarsely punctate; fore and middle tibiae and tarsi black; fore femora infuscated. Length 6 to 6½ mm.

Male: Punctures of vertex a little more widely separated than in *haematopoda;* fore legs and middle tibiae and tarsi infuscated; teeth of sixth tergite black or the lateral ones red, rather long, lateral ones longer than broad, median ones about twice as long as basal width.

So far as known this species is found only in Lower California.

LOWER CALIFORNIA: San Quintin, June 7, 1925 (H. H. Keifer).

Type: male; Monserrate Island, Gulf of California in collection of the California Academy of Sciences.

One or two specimens from Lone Pine, Inyo County, California have dark fore and middle legs, and would appear to belong to *rhodopus*. However, they were collected with numerous specimens of *haematopoda*. If these specimens are really the same as the Lower Californian *rhodopus*, it is probably a subspecies or a synonym of *haematopoda*. A good series of specimens from Lower California would do much to clarify the matter, but since the

several known specimens from that region all have dark anterior legs, it seems probable that *rhodopus* is at least a subspecies.

Ashmeadiella (Ashmeadiella) rufipes Titus

Ashmeadiella rufipes Titus, 1904, Proc. Ent. Soc. Wash., **6**:99, ♀.

Male: Similar to *haematopoda* but median teeth of sixth tergite of abdomen broader basally; punctures of vertex slightly separated, similar to those of scutum; punctures of dorsum of sides of first abdominal tergite finely and closely punctate, in contrast to surrounding areas; fore legs black; middle tarsi black and middle tibiae suffused with black; posterior margins of tergites not reddish; teeth of sixth tergite black. Length 6½ mm.

Female: Similar to *haematopoda* but cheeks more than half as wide as eyes seen from side; fore legs and middle tibiae and tarsi largely black; punctures slightly coarser, about as in rhodopus. Length 7½ mm.

Type: female; San Diego County, California, in collection of the United States National Museum.

This species is known from only two specimens, both collected on August 30, 1891, doubtless in the same place. The male, which is here described for the first time, is in the collection of the California Academy of Sciences, and was collected by Dr. F. E. Blaisdell, who tells me that in all probability it was taken in the vicinity of San Diego, and almost certainly not in the eastern desert portions of the county.

In 1936[4] I regarded this species as a probably synonym of *bigeloviae*. However, having now seen true *rufipes*, I find that it is not closely related to *bigeloviae*, but does fall near to *haematopoda* and *rhodopus*.

Ashmeadiella (Ashmeadiella) leucozona Cockerell

Ashmeadiella leucozona Cockerell, 1924, Proc. Calif. Acad. Sci., (4)**12**:556, ♂ ♀; Michener, 1936, Am. Mus. Nov., **875**:12, 15 (key).

This black, abundantly pubescent species can be easily recognized by the coarsely and sparsely punctate, shining scutum.

Male: Transfacial line considerably longer than facial line; face covered with white hair; under side of flagellum brown; inner orbits converging slightly below, except for lower thirds; apex of clypeus with a weak concavity very little shorter than basal width of clypeus; mandibles with broad red band subapically; punctures of vertex nearly approximate; anterior ocellus distinctly posterior to midpoint between antennal bases and posterior margin of vertex; distance between posterior ocelli distinctly greater than distance to nearest eye margin and a little greater than distance to posterior edge of vertex; cheeks about half as broad as eyes seen from side. Punctures of scutum coarse, separated by nearly their diameters, those of anterior part of scutum slightly finer than those of vertex, those of posterior part of scutum slightly coarser

4 Michener, 1936, Pan-Pac. Ent., **12**:58.

than those of vertex; scutum with band of white pubescence all the way around; tegulae testaceous; punctures of mesepisterna distinctly finer and a little closer than those of scutum; small segments of tarsi red. Punctures of abdomen quite close and strong, separated by less than their diameters, and somewhat finer than those of mesepisterna; teeth of sixth tergite reddish testaceous; lateral teeth of sixth tergite acutely pointed; median teeth in the holotype nearly twice as broad as long, and separated by a concavity which is longer than a semicircle, but in two other specimens (a cotype and the var. a) the median teeth are about as broad as long, and separated by a concavity which is broader than a semicircle; tergites one to five with distinct, broad apical bands of pubescence, usually white but a little yellowish in a cotype. Length 5 to 6 mm.

Female: Eyes converging below; truncation of clypeus slightly concave, shorter than distance from end of truncation to lateral angle of clypeus; cheeks narrower than eyes, seen from side; transfacial line longer than facial; distance between posterior ocelli greater than distance to nearest eye margin, equal to distance to posterior edge of vertex. Length 7 mm.

Although there is considerable variation in the teeth of the sixth tergite of the male, there is probably only one species concerned. The holotype is the only known specimen with broad teeth. The var. a was distinguished by the narrower teeth, but, as stated above, the cotype has similar teeth.

Type: male; Guaymas, Sonora, Mexico, in California Academy of Sciences.

Specimens from the Imperial Valley, California, appear to be this species but the males have narrower faces, and none of them have the broad median teeth of the sixth tergite of the holotype; females have more finely punctate abdomens than in Sonoran specimens.

Ashmeadiella (Ashmeadiella) digiticauda Cockerell

Ashmeadiella digiticauda Cockerell, 1924, Proc. Calif. Acad. Sci., (4)**12**:557, ♂.

This is a black species. The slightly dusky wings and the sparse pubescence, ochraceous on the dorsum of the head and thorax, give this species the aspect of the forms not found in deserts (e.g. *californica*), although this is apparently a desert species.

Male: Transfacial line a little longer than facial line; pubescence of face dense only laterally; inner margins of eyes converging toward clypeus, except for lower thirds, which diverge; under side of flagellum dusky; apex of clypeus with poorly defined, slight emargination about half as wide as basal width of clypeus; clypeus shiny and quite coarsely punctate except apically where the punctures are finer and close; mandibles with dull red transverse bands; distance from bases of antennae to anterior ocellus nearly twice as great as distance from anterior ocellus to posterior edge of vertex; distance between posterior ocelli a little greater than distance to posterior edge of vertex, hardly greater than distance to nearest eye margin; vertex closely punctate, more finely so than clypeus, rather dull; cheeks about half as broad as eyes, seen

from sides. Scutum dull, more finely punctate than vertex, punctures approximate; wings slightly dusky; outer parts of tegulae testaceous; mesepisterna more coarsely punctate than scutum, punctures separated by more or less distinct shiny surface. Abdomen rather strongly punctate, punctures not much separated and larger than those of scutum; lateral teeth of sixth tergite acutely pointed; median teeth rather parallel sided, more than twice as long as broad, not broadened basally, concavity between them longer than a semicircle; tergites one to four with white apical bands of pubescence. Length 5 mm.

Type: male; Tortuga Island, Gulf of California, Mexico, in California Academy of Sciences. This species is known only from the unique type.

Ashmeadiella (Ashmeadiella) floridana (Robertson)

Heriades floridanus Robertson, 1897, Trans. Acad. Sci. St. Louis, **7**:348, ♀.
Eriades floridanus Friese, 1911, Das Tierreich, **28**:28, ♀.
Ashmeadiella floridana Cockerell, 1922, Ann. Mag. Nat. Hist., (9)**10**:545; Michener, 1936, Am. Mus. Nov., **875**:9, ♀ ♂.

This is a black species in which the pubescence is sparse, that of the dorsum of the head and thorax brownish.

Male: Inner margins of eyes converging toward clypeus almost to their lower ends; transfacial line considerably longer than facial line; under side of flagellum brown; clypeus short, not produced, with slight median apical concavity, less than half as wide as basal width of clypeus and demarked by very inconspicuous angles; labrum coarsely punctate; clypeus and supraclypeal area closely punctate, clypeus coarsely so, supraclypeal area finely so; punctures of vertex about as large as those of clypeus, separated by some shiny ground; punctures of frons finer and closer than those of vertex, coarser than those of supraclypeal area; anterior ocellus considerably posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli greater than distance to nearest eye margin, and a little less than distance to posterior margin of vertex; cheeks considerably narrower than eyes, seen from side; punctures of cheeks finer than those of vertex but coarser than those of supraclypeal area, and separated by shiny ground. Scutum posteriorly punctured like vertex, anteriorly more finely and closely so; no pair of pubescent spots at anterior end of scutum; tegulae slightly reddish; mesepisterna punctured like anterior part of scutum; small segments of tarsi reddish; hind tibial spurs serrate, teeth of outer spurs rather oblique. Abdomen strongly punctate, punctures of sides of tergites nearly as large as those of vertex; first tergite, especially laterally, distinctly more finely punctate than second; lateral teeth of sixth tergite broader than long; median teeth about as long as broad, separated by an emargination about as wide as basal width on one of them and longer than a semicircle. Length 6½ mm.

Female: Similar to male. Transfacial line slightly longer than facial; anterior ocellus very slightly posterior to midpoint between bases of antennae and posterior edge of vertex; distance between posterior ocelli a little less than distance from one of them to eye margin, and distinctly less than dis-

tance from one of them to posterior edge of vertex; punctured areas not reaching median pit of propodeum; fifth tergite without distinct apical pubescent band. Length 7-8 mm.

This species has been found in Florida and North Carolina.

Type: female; Inverness, Florida, no doubt in the collection of Charles Robertson.

Since specimens from Florida have not been seen by the author, it is possible that the North Carolina specimens may prove to be a different species. The present description is based upon the previously recorded (Michener, 1936) specimens from Southern Pines, North Carolina.

Ashmeadiella (Ashmeadiella) rufiventris sp. nov.

This is the only species of its subgenus in which the abdomen is almost entirely red. If differs from the species which are perhaps most closely related, such as *coloradensis* and *cactorum*, not only by the abdomen being red, but also by the distance between the posterior ocelli being greater than the distance from one of them to the nearest eye margin.

Female: Inner margins of eyes converging toward clypeus; facial line almost as long as transfacial; face except clypeus densely hairy; flagellum brownish beneath; head rather finely punctate, punctures not quite approximate, those of vertex in particular with some shiny surface between them; clypeal truncation slightly emarginate medially, truncation nearly as long as distance from end of truncation to lateraly angle of clypeus; truncated margin of clypeus narrowly shining and impunctate; mandibles with dark reddish band basad to the teeth; supraclypeal area and clypeus except for margin of truncation more coarsely punctate than vertex and frons, punctures elongated; anterior ocellus considerably posterior to midpoint between antennal bases and posterior margin of vertex; distance between posterior ocelli slightly greater than distance to eye margin, hardly greater than distance to posterior edge of vertex; cheeks more finely punctate than vertex and frons, (usually) narrower than eyes seen from side. Scutum with pubescence forming a pair of somewhat confluent spots anteriorly, punctures (not or) hardly coarser and more distinctly separated than those of vertex; tegulae dark testaceous; wings slightly dusky; punctures of mesepisterna slightly finer and closer than those of scutum; inner margin of inner hind tibial spurs with about thirteen small teeth, outer margin with ten long teeth; outer spurs with about five low, oblique teeth on each margin; hind femora, and hind tibiae except outer side, red; small segments of tarsi (often) largely brown. Abdomen red except for sixth tergite medially (sixth tergite almost entirely black and fourth and fifth with infuscated median areas in some paratypes) and fourth to sixth sternites (third often black medially); punctures, except on dorsum of first two (or three) tergites fine and separated by less than their diameters, those of posterior tergites and sides of abdomen approximate; pubescent fasciae of tergites narrow and inconspicuous, that of fifth tergite present. Length 6¾ mm (varying to 5 mm. in some paratypes).

Male: Similar to female; transfacial line longer than facial; face covered with white pubescence; inner orbits converging below, except for lower parts, which diverge; clypeus finely and closely punctate, with apical emargination more than one-half as long as basal width of clypeus and bounded by distinct angles; distance between posterior ocelli considerably greater than distance to eye or to posterior edge of vertex. Punctures of scutum and scutellum sparser than in female. Abdomen more coarsely punctate than in female, red, third tergite infuscated medially, fourth with large black area medially, fifth and sixth black, sides and posterior margins, including teeth of sixth tergite, red (in some black much more extensive than in allotype); lateral teeth of sixth tergite broader than long, apices acutely angulate; median teeth of sixth tergite broader than long, rounded, concavity between them broader than a semicircle. Length 4½ mm.

Holotype female (Calif. Acad. Sci., Ent. No. 4728) and one female paratype from Dos Palmos, Colorado Desert, California, March 19, 1934 (from M. Cazier collection); one female paratype from same locality, March 28, 1934 (from Bohart collection). Allotype male, Westmoreland, California, March 23, 1938, on *Heliotropium curassavicum* (P. H. Timberlake, in Timberlake collection at Citrus Experiment Station, University of California, Riverside). Additional paratypes, all females: one, five miles west of Indio, California, April 10, 1936, on *Prosopis glandulosa* (C. D. Michener); two, nine miles north of Adelanto, California, April 25, 1937, on *Astragalus fremontii* (P. H. Timberlake); one, Palm Springs, California, April 9, 1936, on *Cercidium torreyanum;* one, same locality, March 26, 1932, on *Phacelia distans* (P. H. Timberlake). Paratypes are in the collections of Messrs. Cazier, Bohart, and Timberlake and the author.

Additional specimens are from two miles south-east of Keeler, Inyo County, California, on *Malacothrix* (C. D. Michener); six miles south of Olancha, Inyo County, June 20, 1937 (E. Gehrhardt); two miles south of Edom, Riverside County, March 8, 1936, on *Geraea canescens* (P. H. Timberlake); Twenty-nine Palms, San Bernardino County, California, April 14, 1938 (G. E. and R. M. Bohart).

Ashmeadiella (Ashmeadiella) prosopidis (Cockerell)

Heriades prosopidis Cockerell, 1897, Ann. Mag. Hist., (6)**20**:140, ♀, nec ♂.
Eriades prosopidis Friese, 1911, Das Tierreich, **28**:30, ♀.
Ashmeadiella prosopidis Cockerell, 1898, Bull. Denison Univ., **11**:64, ♀ (key); Cockerell, 1898, Bull. Univ. New Mex., **1**:64, ♀ (key); Michener, 1936, Am. Mus. Nov., **875**:8, ♀.
Ashmeadiella subangusta Cockerell, 1924, Proc. Calif. Acad. Sci., (4)**12**:588, ♀.

This is a small, slender, sparsely pubescent, black species, closely related to *schwarzi* and *microsoma*. It differs from the former by the longer face, from the latter by the broader cheeks.

Female: Inner margins of eyes slightly converging toward clypeus; under side of flagellum dusky; face elongate, facial line as long as transfacial; clypeus rather coarsely and closely punctate; clypeal truncation slightly concave, as long as distance from end of truncation to lateral angle of clypeus; rest of

head a little more finely and less closely punctate than clypeus; supraclypeal area more finely punctate than vertex or front; anterior ocellus considerably posterior to midpoint between bases of antennae and posterior edge of vertex; distance between posterior ocelli greater than distance to nearest eye margin, and equal to distance to posterior margin of vertex; cheeks considerably narrower than eyes seen from side, more finely punctate than supraclypeal area. Scutum usually somewhat more coarsely and less closely punctate than vertex; mesepisterna punctured like vertex; inner margin of inner hind tibial spurs with about twelve low, blunt, oblique teeth, outer margin with about eight, blunt, oblique teeth; outer spurs with few, low, blunt, oblique teeth on each margin; tegulae dark testaceous. Abdomen strongly punctured, punctures of dorsum of second tergite separated by about their diameters, punctures of sides of tergites and of apical tergites approximate; tergites one to four with apical bands of pubescence; sixth ternite with transverse coarsely punctate depression, posterior to which is a finely punctate area.

Male: Similar to female; pubescence covering most of face; inner orbits converging below, except for lower parts, where they diverge; transfacial line somewhat longer than facial; clypeus very finely and closely punctate, with distinct apical emargination less than half as wide as basal width of clypeus and bounded by distinct angles; distance between posterior ocelli somewhat greater than distance to posterior edge of vertex, distinctly greater than distance to margin of nearest eye; cheeks less than half as wide as eyes, seen from side. Vertex, scutum, and mesepisterna rather coarsely punctate, punctures separated by a little shiny surface; abdomen rather coarsely punctate, punctures separated by but little shiny ground, and smaller than those of vertex; lateral teeth of sixth tergite wider than long, angulate apically; median teeth variable in shape, short, usually rather broad at base, concavity between them broader than a semicircle; teeth of sixth tergite sometimes rufescent. Length 4 mm.

This species is known from the deserts of New Mexico, Arizona, California, and Sonora. It is perhaps oligotropic on *Prosopis*.

ARIZONA: Tucson (H. G. Hubbard, U.S.N.M.) CALIFORNIA: Potholes, Imperial County, April 7, 1928 (E. P. Van Duzee); five miles west of Indio, on *Prosopis glandulosa*, April 10, 1936 (C. D. Michener); Andreas Canyon, near Palm Springs, on *Prosopis glandulosa*, April 10, 1936 (C. D. Michener); Furnice Creek Camp, Death Valley, Inyo County, April 14, 1938, on *Pluchea sericea* (B. E. White), May 1, 1927 (P. H. Timberlake); Near Mecca, April 13, 1934, on *Heliotropium curassavicum;* Coachella, April 23, 1927, on *Prosopis glandulosa;* Box Canyon, April 13, 1934, on *Acacia greggii;* Westmoreland, May 25, 1930, on *Salix nigra* (all collected by P. H. Timberlake). SONORA: San Jose de Guaymas (L. O. Howard, U.S.N.M.).

Type: female; Mesilla, New Mexico.

Ashmeadiella subangusta Cockerell is based on a specimen in which the abdomen is unusually extended.

Ashmeadiella (Ashmeadiella) schwarzi Titus

Ashmeadiella schwarzi Titus, 1904. Proc. Ent. Soc. Wash., **6**:98, ♀ ♂.

This species is perhaps a synonypm of *A. prosopidis*, but since there appear

to be some differences between the two, and since very few specimens of *schwarzi* are known, it seems inadvisable to reduce it to synonomy at the present time.

Female: Similar to *prosopidis* but face round and clypeus less produced.

Male: Similar to *prosopidis* but face broader than long; teeth of sixth tergite rufo-testaceous.

Type: female; Chiricahua Mountains, Arizona, in the United States National Museum.

It is also recorded from other localities in Arizona, but specimens from Guaymas, Sonora, Mexico, recorded as *schwarzi*, are in reality a new species, *sonora*, described below.

Ashmeadiella (Ashmeadiella) microsoma Cockerell

Ashmeadiella microsoma Cockerell, 1924, Proc. Calif. Acad. Sci., (4)**12**:556, ♂.

This, the smallest species in the genus, differs from its relatives by the narrow cheeks.

Male: Transfacial line considerably longer than facial; under side of flagellum brownish; face largely covered with white pubescence; inner margins of eyes converging below, except for lower fourths; clypeus finely punctate, anterior margin with concavity evidently a little less than half as broad as basal width of clypeus; mandibles with a broad, red transverse band on each; cheeks narrow, about one-third as broad as eyes seen from side; anterior ocellus twice as far from antennae as from posterior margin of vertex; distance between posterior ocelli greater than distance to eye or to posterior margin of vertex; punctures of vertex coarser than those of clypeus, slightly separated by shiny surface. Scutum without pubescent spots anteriorly; punctures of scutum like those of vertex but perhaps a little coarser; tegulae testaceous; punctures of mesepisterna slightly finer than those of scutum, but similarly spaced; small segments of tarsi, particularly apical ones, brownish. Punctures of abdomen fairly strong, those of dorsum of second tergite separated by about their diameters, and somewhat finer than those of scutum; apices of tergites slightly brownish; lateral teeth of sixth tergite brownish, acutely pointed; median teeth rather short, parallel sided, a little longer than basal width, concavity between them a little deeper than a semicircle; tergites one to five with apical bands of pubescence, that of fifth tergite rather weak. Length 3½ mm.

Type: male; from Guaymas, Sonora, Mexico, in the California Academy of Sciences. This species is known only from the unique type.

Ashmeadiella (Ashmeadiella) sonora sp. nov.

Ashmeadiella schwarzi, Cockerell (misidentification), 1924, Proc. Calif. Acad. Sci., (4)**12**:555; Michener, 1936, Am. Mus. Nov., **875**:8.

This small, black, sparsely pubescent species is similar to *prosopidis*, *schwarzi*, and *microsoma*, but differs by the long median teeth of the sixth tergite of the male. Furthermore, in *prosopidis* at least, the teeth of the hind

tibial spurs are considerably shorter than in *sonora*. The male differs from *coloradensis* and *curriei* by the long teeth of the sixth tergite, and from *cactorum* and *dimalla* by the position of the anterior ocellus, nearly twice as far from the antennal bases as from the posterior edge of vertex. The female differs from *dimalla* by the weakly emarginate clypeus and smaller size, and from that species as well as from *cactorum* and *coloradensis* by the narrow cheeks and the unusually extensive impunctate area of the posterior face of the propodeum.

Male: Transfacial line longer than facial; inner margins of eyes distinctly converging toward clypeus, except for lower ends; face largely covered with white pubescence; under side of flagellum brownish; clypeus finely and closely punctate, apical margin shiny with median emargination a little over half as wide as basal width of clypeus and demarked by distinct angles; mandibles reddish except basally; anterior ocellus far posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli somewhat greater than distance to nearest eye margin or to posterior margin of vertex; vertex and frons strongly punctate, punctures of frons approximate, those of vertex nearly so; cheeks about one-third as wide as eyes, seen from side. Scutum punctured like vertex; tegulae dark brown; scutum margined laterally with white hair, and with a pair of pubescent spots anteriorly; mesepisterna more coarsely punctate than scutum, punctures slightly separated; wings clear; legs slightly brownish; inner margin of inner hind tibial spurs with about eleven teeth, outer margin with about eight; outer spurs with six or seven low oblique teeth on each margin. Abdomen rather strongly punctured, punctures rather close, not as coarse as those of scutum; posterior margins of tergites brownish, with bands of white pubescence; teeth of sixth tergite rufo-testaceous, lateral ones a little longer than wide and acutely pointed, median ones rather long, somewhat broadened basally, not twice as long as width at base, subparallel sided apically, apices rounded, emargination between them longer than a semicircle. Length less than 4 mm.

Female: Similar to male, differing thus: inner margins of eyes converging below; face not densely pubescent except laterally; clypeus as coarsely punctate as vertex except for broad, smooth, reddish, apical margin; truncation of clypeus hardly concave, slightly shorter than distance from its end to lateral angle of clypeus; angles marking ends of clypeal truncation somewhat elevated and rounded; mandibles with reddish, transverse, subapical band; distance from first to third mandibular tooth but little more than half width of eye, and less than length of last three antennal segments; cheeks between one-third and one-half as wide as eyes, seen from side. Spots of pubescence at anterior end of scutum inconspicuous (or worn?); median posterior pit of propodeum not closely approached by punctured areas; teeth of outer side of inner hind tibial spur longer than in male; fifth tergite with apical pubescent band present only laterally; scopa whitish.

Holotype male (Calif. Acad. Sci., Ent. No. 4729) and allotype female (Calif. Acad. Sci., Ent. No. 4730) from Guaymas, Sonora, Mexico, April 8, 1921 (E. P. Van Duzee).

A male in poor condition from Shavers Well, Riverside County, California, April 8, 1934 (Bohart collection); a female from Morengo Valley, San Bernardino County, California, April 20 (T. D. A. Cockerell); a female from Box Canyon, April 12, 1934, on *Olneya tesota* (P. H. Timberlake); and two females from six miles south of Palm Springs, California, June 8, 1937, on *Hugelia virgata* (P. H. Timberlake) belong to this species. The fresh Californian examples have two large and sometimes confluent patches of white pubescence on the anterior edge of the scutum.

Ashmeadiella (Ashmeadiella) altadenae Michener

Ashmeadiella altadenae Michener, 1936, Pan-Pac. Ent., **12**:63, ♂; Michener, 1936, Am. Mus. Nov., **875**:14 (key); Michener, 1937, Ann. Mag. Nat. Hist., (10)**19**:406.

This is a small, black, rather densely pubescent species, with brown tarsi. The pubescence of the dorsum is often brownish or yellowish.

Male: Inner margins of eyes slightly converging toward the clypeus or nearly parallel, except for lower portions which diverge; face covered with pubescence; transfacial line longer than facial; head rather finely and closely punctate; flagellum light brown beneath; anterior margin of clypeus with slight emargination, shorter than basal width of clypeus and bounded by weak angles; mandibles dark red except for basal and apical extremities; anterior ocellus slightly posterior to midpoint between bases of antennae and posterior edge of vertex; distance between posterior ocelli equal to distance to nearest eye margin but distinctly less than distance to posterior edge of vertex; cheeks about half as wide as eyes, seen from side. Scutum with band of pubescence around it, broadened anteriorly but without separate spots of pubescence anteriorly; scutum more coarsely punctate than vertex, punctures separated by some shiny surface; mesepisterna punctured about as vertex; tegulae dark brown; trochanters and apices of femora brownish; hind tibial spurs very finely serrate on each margin; tarsi light brown. Abdomen finely punctured, punctures of posterior tergites about as coarse as those of vertex; lateral teeth of sixth tergite a little longer than broad; median teeth about twice as long as broad, parallel sided, distance between them at apices hardly greater than twice width of one of them at apex; abdominal bands of pubescence narrow, made up about equally of pubescence on bases and apices of tergites, so that bands often appear to be split. Length 4 to 4½ mm.

CALIFORNIA: Hastings Natural History Reservation, near Jamesburg, Santa Lucia Mountains, Monterey County, elevation 2000 feet, June 8, 14, and 24, 1938, one on *Adenostoma fasciculatum* and one on *Lotus scoparius* (C. D. Michener).

Type: male; Altadena, California, on loan deposit in the California Academy of Sciences.

Ashmeadiella (Ashmeadiella) rufitarsis sp. nov.

This is a small and highly variable, finely punctate, species, closely related to *altadenae*, from which it differs by its smaller size, position of the ocelli (anterior one being well behind midpoint between antennal bases and poster-

ior edge of vertex), and the somewhat more slender median teeth of the sixth tergite of the male. The female of *altadenae* is unknown, but the female of *rufitarsis* is similar to *sonora,* from which it differs by finer punctation and slightly broader cheeks.

Female: Pubescence pale brownish, that of sides of face, cheeks, and sides of thorax whiter; inner margins of eyes distinctly converging toward clypeus; transfacial line longer than facial; flagellum light brown beneath; clypeus finely and rather closely punctate, anterior margin reddish brown, narrowly impunctate, truncation slightly concave, shorter than distance from its end to eye, ends of truncation prominent and slightly elevated; mandibles red, except black bases and darkened teeth; distance from first to third mandibular tooth much less than width of eye, less than length of last three antennal segments together; cheeks more finely punctate than clypeus, a little more than one-half width of eyes seen from side; anterior ocellus much farther from antennal bases than from posterior edge of vertex; distance between posterior ocelli hardly greater than distance to eye or to posterior edge of vertex; vertex and frons slightly more coarsely punctate than clypeus. Scutum distinctly more sparsely punctate than vertex, without spots of pubescence anteriorly; tegulae testaceous; mesepisterna more finely punctate than scutum; wings slightly dusky; inner margins of inner hind tibial spurs finely serrate with about sixteen small teeth, outer margin with about fourteen very small teeth; outer margin of outer spur with about eight very small teeth, inner margin with fewer similar teeth; tarsi, extreme apices of femora, inner sides of hind tibiae, and to a lesser degree, femora, testaceous. Abdominal tergites distinctly punctured, more finely so than scutum, punctures on dorsum of second tergite separated by about one puncture width; sides and posterior margins of first two tergites, and extreme sides of other tergites, red; posterior margins of other tergites testaceous (in paratypes varying from abdomen almost entirely black except for testaceous margins of tergites to abdomen red except for last two tergites which are black); tergites one to five with apical bands of white pubescence; scopa thin, whitish. Length nearly 4 mm. (fully 4 mm. in some paratypes).

Male: Similar to female; clypeus slightly more finely punctate than vertex; emargination of apical edge of clypeus much shorter than basal width of clypeus and demarked by rather distinct angles; face largely covered with brownish pubescence; distance between posterior ocelli slightly greater than distance to eye or to posterior edge of vertex; tibial spurs similar to those of female; tarsi, extreme apices of femora, and inner sides of apices of hind tibiae rufotestaceous, contrasting more conspicuously with rest of legs than in female. Abdomen black, posterior margins of tergites and teeth of sixth tergite rufotestaceous; lateral teeth of sixth tergite broader than long (longer in some paratypes); median teeth nearly twice as long as broad, rather broad, parallel sided, separated subapically by nearly three times subapical width, emargination between them deeper than a semicircle. Length 3½ mm. (varying to 4 mm.)

The punctation, especially in the male, varies considerably, that of scutum being often distinctly finer as well as sparser than that of vertex.

Holotype female, allotype male, and eleven paratypes: Mount Diablo, Contra Costa County, California, 3800 feet elevation, June 14, 1933, on *Eriogonum gracile* (P. H. Timberlake). Mr. Timberlake has taken one additional specimen from each of the following localities: one and one-half miles west of Perris, California, June 21, 1938, flying over ground; San Lucas, August 20, 1935, on *Eriogonum gracile*. Except for two paratypes in my collection, the types have been returned to the Timberlake collection at the Citrus Experiment Station, Universtiy of California, Riverside.

The name *rufitarsis* was applied to this species by Mr. P. H. Timberlake, to whom I am indebted for the opportunty to study it.

Ashmeadiella (Ashmeadiella) foveata sp. nov.

This is a rather large, black, sparsely pubescent form, distinguished from all other species by the large, depressed, very coarsely punctate area on the sixth sternite which extends to the posterior margin of the sternite. There is a similar although smaller depression which does not attain the posterior margin of the sternite in *prosopidis*. *A. foveata* is distinguished from the *cactorum* group, to which it is possibly most closely related, by the fine, close punctation, in addition to the foveate sixth sternite.

Female: Inner margins of eyes converging toward clypeus; facial line shorter than transfacial; flagellum dark brown beneath; clypeal truncation distinctly concave, shiny margined, its ends rounded, distinctly shorter than distance from ends to eye margins; clypeus shiny and coarsely punctate except for preapical area which is dull and more finely and closely punctate; mandibles dark reddish subapically, with distance from first to third tooth much less than greatest width of eye, and less than length of last three antennal segments together; cheeks narrower than eyes, seen from side, and very finely punctate; vertex and frons, especially the latter, finely and closely punctate; anterior ocellus distinctly behind midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli about equal to distance to eyes or to posterior edge of vertex. Scutum punctured like vertex, without pair of pubescent spots anteriorly; tegulae dark rufotestaceous; mesepisterna punctured like scutum; wings faintly dusky; inner margin of inner hind tibial spurs with about fifteen somewhat oblique teeth, outer margin with about ten similar teeth; outer hind tibial spurs with about seven teeth on each margin. Abdominal tergites rather strongly punctate, more finely so than scutum, punctures of dorsum of second tergite separated by slightly less than their diameter; tergites one to five with apical bands of white pubescence; scopa short, sparse, yellowish white, nearly absent on sixth sternite, which has a large, shining depression, nearly as broad as the sternite and extending nearly to posterior margin of sternite; punctures of this depression very large, rather widely separated, especially medially, and rather irregularly shaped. Length 7 mm. (5 mm. in one paratype).

Holotype: Tamalpias, California, June 20, 1926 (O. H. Swezey). One paratype, same locality and date, on *Erigeron miser*, (P. H. Timberlake); one paratype, Green Vaalley, California, June 9, 1933, on *Diplacus aurantiacus* (P. H. Timberlake). Two additional specimens are from Oak Creek Canyon, near Independence, Inyo County, California, June 11, 1937 (E. C. Van Dyke, C. D. Michener). These are slightly more coarsely punctate than the type material.

The type and paratypes are in the collection of Mr. P. H. Timberlake at the Citrus Experiment Station, University of California, Riverside. The name used for this species was suggested by Mr. Timberlake.

Ashmeadiella (Ashmeadiella) cockerelli Michener

Ashmeadiella cockerelli Michener, 1936, Pan-Pac. Ent., **12**:62, ♂; Michener, 1936, Am. Mus. Nov., **875**:15 (key).

This is a small, robust, black species, notable for the unusually sparse abdominal punctures.

Male: Inner margins of eyes converging toward clypeus except for lower parts which are subparallel; face nearly bare except for white pubescence on sides and on anterior margin of clypeus; mandibles reddish subapically; under side of flagellum brownish; anterior margin of clypeus with rather distinct emargination, shorter than basal width of clypeus, demarked by distinct angles, margin of emargination shiny and impunctate; head rather coarsely and closely punctate, anterior part of clypeus finely and closely so, supraclypeal area very closely so, cheeks more finely and sparsely so; cheeks slightly narrower than eyes, seen from side; anterior ocellus slightly posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli about equal to distance to nearest eye margin, distinctly less than distance to posterior edge of vertex. Scutum rather finely and closely punctate anteriorly, more coarsely and less closely punctate medially and posteriorly, some of punctures in center separated by nearly their diameters; scutum without pair of tufts of pubescence anteriorly; mesepisternum punctured like posterior part of scutum, punctures much sparser below; tegulae piceous; wings slightly dusky; apical segment of each tarsus brownish. Punctures of abdomen fine, nowhere approximate or as coarse as those of posterior part of scutum; punctures of abdomen coarsest on posterior tergites laterally, very fine on anterior tergites dorsally, those of first and second tergites dorsally separated by more than their diameters; posterior margins of tergites narrowly brownish; teeth of sixth tergite brownish, median ones broadly conical in outline, emargination between them broader than a semicircle; posterior margins of tergites one to five with inconspicuous bands of white pubescence. Length nearly 5 mm.

Type: male; Altadena, California, on loan deposit to California Academy of Sciences.

This species is known only from the unique type.

Ashmeadiella (Ashmeadiella) difugita sp. nov.

This species is superficially similar to *femorata* and *titusi*, but differs from them by the slender, nearly straight, finely serrate hind tibial spurs, and the longer face. It differs also from *haematopoda* and its relatives by the much less abundant white pubescence and the blacker legs. In spite of its red hind femora, it seems likely that this species is most closely related to *cactorum*, although it is somewhat more finely and closely punctate than that species.

Female: Inner margins of eyes converging toward clypeus; facial line about as long as transfacial; flagellum dark brown beneath; truncation of clypeus feebly concave, with impunctate margin, and slightly shorter than distance from its end to eye margin; clypeus, except for apical margin and finely punctate preapical part, shining and coarsely punctate; mandibles with red subapical band, distance from first to third tooth much less than greatest width of eye and less than length of last three antennal segments together; cheeks considerably more finely punctate than vertex, narrower than eyes, seen from side; anterior ocellus much farther from antennal bases than from posterior edge of vertex; posterior ocelli separated by distance slightly less than (or about equal to) distance to eye and to posterior edge of vertex; vertex, supraclypeal area, and frons, especially the latter, finely and closely punctate in contrast to clypeus. Scutum hardly more coarsely punctate than vertex, without pair of pubescent spots anteriorly; tegulae somewhat brownish; mesepisterna nearly as coarsely punctate as and a little more sparsely punctate than scutum; wings slightly dusky; hind femora red; inner sides of hind tibiae red; middle femora with inconspicuous reddish areas (absent in paratypes); hind tibial spurs rather straight and finely serrate, inner margin of inner spurs with about seventeen small teeth, outer margin with about eleven; outer spurs with eight or nine teeth on each margin. Abdomen considerably more finely punctate than scutum, punctures of first three tergites medially separated by about twice their diameters; tergites one to five with apical bands of white pubescence; scopa whitish. Length 5½ mm. (5 mm. in one paratype).

Male: Similar to female; anterior margin of clypeus with rather deep emargination, shorter than basal width of clypeus and demarked by rounded angles; clypeus more finely punctate than in female, although nevertheless (except anteriorly) considerably more coarsely so than vertex; cheeks considerably narrower than eyes, seen from side; distance between posterior ocelli about equal to distance to eye and to posterior edge of vertex. Scutum not more coarsely punctate than vertex, but a little more sparsely so; mesepisterna more coarsely punctate than scutum (not so in some paratypes). Abdominal punctures slightly closer but not coarser than those of female; lateral teeth of sixth tergite longer than broad, apices acutely angulate; median teeth more than twice as long as broad, apical parts parallel sided. Length 5 mm. (varying to 4 mm.)

Holotype female: Lone Pine Canyon, San Gabriel Mountains, California, July 4, 1933, on *Eriodictyon trichocalyx* (P. H. Timberlake). Allotype male: Big Pines Camp, San Gabriel Mountains, July 13, 1927, on *Verbena* (P. H. Timberlake). Paratypes: One female, near falls, Mill Creek Canyon, San

Bernardino Mountains, California, 6200 feet elevation, August 15, 1934, on *Chrysopsis fastigiata* (P. H. Timberlake); one male, Camp Baldy, San Gabriel Mountains, August 21, 1929, on *Eriogonum fasciculatum* (P. H. Timberlake); two males, Swartout Valley, San Gabriel Mountains, California, June 3, 1928, one on pink *Gilia*, the other on *Phacelia heterophylla*. All the above type material is in the Timberlake collection at the Citrus Experiment Station of the University of California at Riverside.

A female from Truckee, California, July 5, 1927 (E. P. Van Duzee) and a male from Tuber Canyon, Panamint Mountains, Inyo County, California, 8000 feet elevation, June 18, 1937 (C. D. Michener) are this species. A female from Arroyo Seco, San Gabriel Mountains, California, July 6, seems to belong here, but is smaller and has a shorter face.

Ashmeadiella (Ashmeadiella) cactorum cactorum (Cockerell)

Heriades cactorum Cockerell, 1897, Ann. Mag. Nat. Hist., (6)**20**:140, ♀.

Eriades cactorum Friese, 1911, Das Tierreich, **28**:30, ♀.

Ashmeadiella cactorum Cockerell, 1898, Bull. Denison Univ., **11**:64, ♀ (key); Cockerell, 1898, Bull. Univ. New Mex., **1**:64, ♀ (key); Cockerell, 1900, Am. Nat., **34**:488 (record); Cockerell, 1901, Ann. Mag. Nat. Hist., **7**(7):129, ♂ (record); Cockerell and Atkins, 1902, Ann. Mag. Nat. Hist., (7)**9**:233 (list); Viereck, 1903, Trans. Am. Ent. Soc., **29**:46 (record); Cockerell, 1931, Ann. Mag. Nat. Hist., (10)**8**:543 (key).

Ashmeadiella cactorum cactorum Michener, 1936, Am. Mus. Nov., **875**:8, ♀♂.

Heriades meliloti Cockerell, 1897, Ann. Mag. Nat. Hist., (6)**20**:141, ♂♀.

Eriades meliloti Friese, 1911, Das Tierreich, **28**:30, ♂.

Ashmeadiella meliloti Cockerell, 1898, Bull. Denison Univ., **11**:64, ♂ (key); Cockerell, 1898, Bull. Univ. New Mex., **1**:64, ♂ (key); Cockerell 1922, Ann. Mag. Nat. Hist., (9)**10**:545, ♂ (record).

This is a moderate sized, black, sparsely pubescent, coarsely punctate species. It is related to *gillettei* and *dimalla*, from the first of which it is distinguished by the long teeth of the sixth tergite of the male, and from the second of which it is distinguished by the feebly concave clypeal margin of the female.

Female: Inner margins of eyes converging toward clypeus; flagellum brown beneath; truncation of clypeus slightly concave; impunctate margin of clypeal truncation narrow medially, broadened towards ends of truncation, which is shorter than distance from ends to lateral angles of clypeus, and which is demarked by slightly rounded angles; distance from first to third mandibular tooth distinctly less than width of eye and slightly less than length of last three antennal segments; anterior ocellus somewhat posterior to midpoint between bases of antennae and posterior edge of vertex; distance between posterior ocelli equal to or slightly less than distance to nearest eye margin or to posterior margin of vertex; cheeks slightly more than half as wide as eyes, seen from side; head rather coarsely and closely punctate, upper part of clypeus and vertex more coarsely so than elsewhere and punctures separated by some shiny ground. Scutum punctured about as vertex, or often

more finely so in this subspecies, with pair of inconspicuous pubescent spots anteriorly; tegulae black, rarely brownish; apical segment of each tarsus rufescent; inner margin of inner hind tibial spurs with about fifteen small teeth, outer margin with about nine long teeth; outer spurs with about seven, somewhat oblique, teeth on each margin; mesepisterna hardly more finely punctate than scutum. Abdomen strongly punctate, punctures of dorsum of second tergite separated by much less than their diameters; punctures of sides of abdomen and of apical tergites nearly as large as those of scutum, approximate; apical pubescent band of fifth tergite nearly absent, although those of preceding tergites are conspicuous. Length 6 to 8 mm.

Male: Similar to female; inner margins of eyes converging toward clypeus, except for lower portions, which diverge; margin of clypeus with concavity distinctly shorter than basal width of clypeus and demarked laterally by distinct, rounded angles; clypeus more finely punctate than vertex; mandibles reddish subapically; anterior ocellus often very near midpoint between bases of antennae and posterior edge of vertex; lateral teeth of six tergite somewhat broader than long, acutely pointed; median teeth variable in width, usually about twice as long as basal width, concavity between them longer than a semicircle; posterior margins of tergites slightly brownish. Length 6 mm.

This form is found from Texas and New Mexico to the desert regions of southern California, and south into northern Mexico.

NEW MEXICO: Rincon, July 5, on *Chilopsis* (T.D.A. Cockerell); Alamogordo, June 9, 1902 (H. L. Viereck, Acad. Nat. Sci. Phila); High Rolls, June 13, 1902 (Acad. Nat. Sci. Phila.); six miles east of Embudo, August 25, 1931, on *Cleome serrulata* (P. H. Timberlake). ARIZONA: Prescott (Oslar, U. S. N. M.); and June 27, 1932, on *Crusea subulata* (P. H. Timberlake); five miles north of Prescott, July 4, 1932, on *Pentstemon* (P. H. Timberlake). SONORA: San Jose de Guaymas, April (L. O. Howard, U. S. N. M.) CALIFORNIA: Andreas Canyon, near Palm Springs, October 27, 1934, on *Solidago californica;* Riverside, September 15, 1932, on *Eriogonum gracile* and May 24, 1933, on *Phacelia ramosissima;* Clark Mountains, 4000 feet, on *Baileya multiradiata* and 4500 feet elevation, on *Vigueria nevadensis*, July 7, 1938; San Felipe Creek, June 5, 1936, on *Opuntia megacarpa*, September 10, 1938, on *Gutierrezia californica;* Blythe, July 15, 1938, on *Prosopis glandulosa* (all P. H. Timberlake). LOWER CALIFORNIA: Cedros Island, June 4, 1925 (H. H. Keifer, Calif. Acad. Sci.)

A female specimen with testaceous tegulae is from Runge, TEXAS, September 20, 1904 (J. C. Crawford). Another female from Tlahualilo, DURANGO, Mexico, July, 1905 (A. W. Morrill, U. S. N. M.) is unusually densely pubescent, and has a pair of distinct pubescent spots at the anterior edge of the scutum. The type series of *cactorum* contains some specimens with somewhat testaceous tegulae, but the large size, rather dense pubescence, and somewhat dense punctures of upper part of clypeus separate them from *aridula*.

Type: Female; from Santa Fe, New Mexico.

I have designated as lectotype of *meliloti (=cactorum)* a specimen marked "type" which is in the United States National Museum. Another specimen, similarly marked and also from the type locality, is *bucconis denticulata*. It is from specimens such as this last that Cockerell later described *wislizeni*.

Ashmeadiella (Ashmeadiella) cactorum astragali subsp. nov.

This subspecies differs from all the other forms of *cactorum* by the distinct apical band of pubescence on the fifth tergite of both sexes and by the infuscated testaceous tegulae, which are quite strongly punctured except near the center.

It had been my intention to describe this as a distinct species, but Mr. P. H. Timberlake shows me specimens which indicate that it intergrades with *cactorum*. There is a more or less evident pair of pubescent spots at the anterior edge of the scutum. This form differs from *gilletti*, which it resembles in many ways, by the long median teeth of the sixth tergite of the male.

Holotype female (Calif. Acad. Sci., Ent. No. 4731), allotype male (Calif. Acad. Sci., Ent. No. 4732): Lone Pine, Inyo County, California, May 24, 1937, on *Astragalus bolanderi* (C. D. Michener). Ninety-two paratypes from same locality collected on various dates from May 24 to June 15, 1935, mostly on *Astragalus bolanderi* but a few on *Cleomella obtusifolia, Heliotropium curassavicum, Glycyrrhiza lepidota,* and *Trifolium* (E. C. Van Dyke, C. D. Michener). A few specimens were also taken on *Parosela polyadenia.*

Additional localities for the subspecies are, NEVADA: Nixon, June 29 and 30, 1927 (E. P. Van Duzee). CALIFORNIA: Big Pine, Inyo County, June 8, 1937, on *Parosela polyadenia* (C. D. Michener); north end of Owens Lake, Inyo County, June 4, 1937, on *Trifolium* (C. D. Michener).

Certain specimens recorded under *aridula* from Lindsay and Barstow, and the San Bernardino, San Gabriel, and Santa Ana Mountains, California, and Buckeye, Arizona, have rather strongly punctured tegulae and in some cases a hair band on the fifth tergite, thus approaching *astragali.*

Ashmeadiella (Ashmeadiella) cactorum crassa (Cockerell)

Ashmeadiella crassa Cockerell, 1924, Proc. Calif. Acad. Sci., (4)**12**:558, ♀ (part).

Female: Differs from typical *cactorum* in slightly finer punctation.

Although this form is probably a synonym of *cactorum,* the endemism which is characteristic of Lower California, and my failure to find specimens like the type of *crassa* from other parts of the range of *cactorum* have led me to refrain from placing *crassa* in the synonymy at present.

Type: Female; San Francisquito Bay, Lower California, Mexico, in collection of the California Academy of Sciences.

The unique type is the only specimen known, the "cotype" being *clypeodentata,* the Californian record being based on *californica.*

Ashmeadiella (Ashmeadiella) cactorum aridula (Cockerell)

Ashmeadiella aridula Cockerell, 1910, Entom., **43**:91, ♂; Cockerell, 1910, Univ. Colo. Stud., **7**:192 (key); Cockerell, 1931, Ann. Mag. Nat. Hist., (10)**8**:543 (key).
Ashmeadiella cactorum aridula Michener, 1936, Am. Mus. Nov., **875**:9, ♂, ♀.

Similar to typical *cactorum* but smaller; punctures of upper part of clypeus of female approximate; tegulae testaceous; scutum without pair of pubescent spots anteriorly (these weak or nearly absent in typical *cactorum*); teeth of outer margin of inner hind tibial spurs commonly somewhat shorter than in typical *cactorum*.

This is one of the most common species of *Ashmeadiella* in southern California west of the deserts, and ranges thence northward to Washington and Idaho and east to western Colorado. The type is from the latter locality, and it is possible that it represents a single peculiar specimen from a population of typical *cactorum,* in which case *aridula* will fall as a synonym of *cactorum* and a new name will be required for the western form. The matter will have to be settled by additional specimens from the type locality.

IDAHO: Lewiston, July 15, 1925 (C. L. Fox, Calif. Acad. Sci.). WASHINGTON: Wawawai, July 12, 1925 (C. L. Fox, Calif. Acad. Sci.). OREGON: Dixie, July 8, 1931 (J. Nottingham, Univ. of Kansas). CALIFORNIA: Stockton, August 20, 1919 (E. P. VanDuzee); Idyllwild, June 29, 1928 (E. C. VanDyke); Bass Lake, Madera County, July 23, 1934 (F. E. Blaisdell); Hemit Lake Road, Herkey Creek, Riverside Counyt, June 24, 1934 (I. McCracken); Banning, May 28, 1928 (E. C. Van Dyke); Mokelumne Hill, June (F. E. Blaisdell); Los Banos, May 23, 1918 (E. P. Van Duzee) (all in Calif. Acad. Sci.); Antioch, August 9 and 23, 1936 (E. C. Van Dyke, R. L. Usinger, C. D. Michener); Friant, May 24, 1936 (M. Cazier); Carrville, Trinity County, June 20, 1934 (G. E. Bohart); Crestline, San Bernardino Mountains, May 23, 1936, on *Lotus* (E. G. Linsley); Escondito (U. Lanham); Fresno (E. A. Schwarz, U. S. N. M.); Marsh Creek, Contra Costa County, August 25, 1911 (J. C. Bridwell); Redlands (F. R. Cole, U. S. N. M.); between Eureka and Weaverville, July 20, 1937 (F. X. Williams); Sacramento, July 4, 1914 (H. S. Smith); Yosemite Valley, June 24, 1921, on *Lotus;* Barstow, September 12, 1924, on *Cleomella obtusifolia;* Coffee Camp, June 8, 1925, on *Lotus glaber;* Pinecrest, July 20, 1929, on *Solidago californica;* Lyttle Creek, July 4, 1928 (H. S. Smith); Lindsay, June 19, 1929; Riverside, July 12 to September 25, some on *Heliotropium curassavicum;* Whittier, August 13, 1920; Herkey Creek, San Jacinto Mountains, 4000 feet elevation, on *Lotus americanus;* Santa Ana Mountains, above Elsinore, April 28, 1934, on *Cryptantha intermedia;* near Holtville, March 24, 1930, on *Heliotropium curassavicum* (all P. H. Timberlake). ARIZONA: Buckeye, March 28, 1934, on *Heliotropium curassavicum* (P. H. Timberlake).

Certain specimens from Buckeye, Arizona, and Lindsay and Barstow and the localities in the San Gabriel, San Bernardino, and Santa Ana Mountains, California, have punctured tegulae and a more or less pubescent margin on the fifth tergite, thus approaching *astragali.* Mr. Timberlake has taken two quite typical specimens of *cactorum* in Riverside, California, possibly indicating that *cactorum* and *aridula* are distinct species. If this is true, *crassa* would belong with *cactorum* and *astragali* with *aridula.*

Type: Male; Rifle, Colorado, in Timberlake collection at the Citrus Experiment Station, University of California, Riverside, from which it will eventually go to the California Academy of Sciences.

Ashmeadiella (Ashmeadiella) dimalla sp. nov.

This species is black, robust, and rather abundantly pubescent. It differs from related species such as *gillettei* by the robust form, the strongly concave

truncation of the clypeus of the female, and the long median teeth of the sixth tergite of the male.

Female: Inner margins of eyes slightly converging toward clypeus; facial line at least as long as transfacial; under side of flagellum brownish; truncation of clypeus shorter than distance from end of truncation to lateral angle of clypeus; truncation broadly V-shaped emarginate (Fig. 9, Pl. 1); clypeus rather coarsely and closely punctate, more finely so anteriorly, anterior margin itself smooth; distance from first to third mandibular tooth distinctly less than width of eye; cheeks narrower than eyes, rather finely punctate; vertex and frons considerably more finely punctate than clypeus, punctures rather close; distance from anterior ocellus to antennal bases slightly more than distance to posterior margin of vertex; distance between posterior ocelli slightly greater than distance to posterior edge of vertex, about equal to distance to eye margin. Scutum with punctation similar to that of vertex, and with pair of small, pubescent spots anteriorly; tegulae dark brown; wings clear; mesepisterna somewhat more coarsely punctate than scutum; claw segments of tarsi rufescent; inner margins of inner hind tibial spurs finely serrate with over twenty small teeth, outer margin with eleven rather long teeth; outer spurs with about eight and ten oblique teeth on inner and outer margins respectively. Punctures of abdomen relatively close, nearly as large as those of scutum on dorsum of anterior tergites, larger than those of scutum posteriorly and laterally; tergites one to five with distinct apical bands of white pubescence; scopa white. Length nearly 7 mm.

Male: Similar to female. Inner margins of eyes slightly converging toward clypeus except for lower ends which diverge; clypeus more coarsely punctate than vertex, except anteriorly where punctures are fine; anterior margin of clypeus with broad, weak concavity, narrower than basal width of clypeus; face, except center of clypeus, largely covered with white pubescence; upper part of cheeks more coarsely punctate than vertex and frons, which are quite finely and closely punctate; distance between posterior ocelli slightly greater than distance from one of them to nearest eye margin or to posterior edge of vertex; outer teeth of sixth tergite subacute; median teeth elongate, nearly twice as long as basal width, slender and subparallel sided apically, somewhat broadened basally, concavity between them distinctly longer than semicircle. Length 8 mm. (abdomen straightened).

Holotype female and allotype male: Flagstaff, Arizona, June 10 and 11, 1909, on flowers of *Iris* (F. C. Pratt, U.S.N.M.).

Ashmeadiella (Ashmeadiella) gillettei Titus

Ashmeadiella gillettei Titus, 1904, Proc. Ent. Soc. Wash., **6**:100, ♀; Cockerell, 1907, Univ. Colo. Stud., **4**:253.

Ashmeadiella coloradensis Cockerell, 1934, Am. Mus. Nov., **732**:4, ♂; Michener, 1936, Am. Mus. Nov., **875**:2, ♀, ♂.

This is a moderate sized, sparsely pubescent species, black or with the hind legs and abdomen partly red.

Female: Inner margins of eyes converge toward clypeus; under side of flagellum dusky or brown; clypeus with weakly concave truncation, shorter than distance from end of truncation to lateral angle of clypeus; punctures of clypeus coarse and close, somewhat longitudinally elongate; distance from first to third mandibular tooth less than greatest width of eye, slightly less than length of last three antennal segments; cheeks narrower than eyes seen from side; anterior ocellus slightly posterior to midpoint between bases of antennae and posterior edge of vertex; distance between posterior ocelli equal to distance to nearest eye margin, slightly less than distance to posterior margin of vertex; punctures of vertex approximate or nearly so, sometimes a little coarser than those of frons, which are approximate; punctures of cheeks finer than those of frons. Scutum punctured like vertex, anterior spots of pubescence weak; tegulae testaceous; wings slightly grayish; mesepisterna more finely punctate than scutum; claw segments of tarsi rufescent; hind femora and inner side of hind tibiae sometimes red, amount of red variable; inner margin of inner hind tibial spurs serrate with about fifteen small teeth, outer margin with about eight long teeth; outer hind tibial spurs with five or six rather large teeth on each margin. Abdomen strongly punctured, punctures of dorsum of second tergite separated by about their diameters; punctures of posterior tergites and sides of abdomen larger and closer, about as coarse as those of mesepisterna. Abdomen black or with first tergite except small mid-dorsal area, second except for large mid dorsal area, and lateral areas on third red; tergites one to five with distinct apical bands of pubescence. Length 6 to 7 mm.

Male: Similar to female but differing thus: Inner margins of eyes converging toward clypeus, except for lower parts which diverge; clypeus finely and closely punctate, much more finely so than rest of head, except for the narrow, smooth, apical margin; apex of clypeus with median concavity a little narrower than basal width of clypeus and demarked by a distinct angle on each side; distance between posterior ocelli greater than distance to nearest eye margin, usually slightly more than distance to posterior edge of vertex. Punctures of mesepisterna rather widely separated; spots of pubescence at anterior end of scutum absent; sixth tergite with lateral teeth considerably broader than long, median teeth broader than long, rounded conical or subtruncate, concavity between them a semicircle or slightly longer than or shorter than a semicircle. Length 5 to 6½ mm.

Although in 1936 I suggested that there might be two species confused under the name *coloradensis* because of variability in the sixth tergite of the males, additional material now at hand indicates that this is not the case. We are dealing instead with a highly variable species.

So far as known, this species is found only in Colorado, on the eastern slope of the Rocky Mountains and on the plains to the eastward. The Californian record given by me in 1936 is probably incorrect, as was suggested at the time.

COLORADO: Sterling, Logan County, June 18, 1923 (G. Sandhouse, U. S. N. M.);

Mountain Home Lake, Fort Garland, 8300 feet altitude, August 20 to 25, 1932 (Am. Mus. Nat. Hist.)

Type: Female; Fort Collins, Colorado, in the United States National Museum.

Ashmeadiella (Ashmeadiella) bequaerti Cockerell

Ashmeadiella bequaerti Cockerell, 1931, Ann. Mag. Nat. Hist., (10)**8**:543, ♂.

This species is black and sparsely pubescent. It represents the most southern known record for the genus.

Male: Transfacial line longer than facial; clypeus more coarsely punctate than rest of head, its anterior margin with faint emargination nearly as wide as basal width of clypeus and demarked laterally only by the very weak, rounded ends of the emargination; mandibles reddish subapically; flagellum dark brown beneath; supraclypeal area closely and rather finely punctate; anterior ocellus somewhat posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli slightly greater than distance to eye margin, slightly less than distance to posterior margin of vertex; vertex and frons a little more finely punctate than supraclypeal area. Scutum hardly more coarsely punctate than vertex, punctures approximate; tegulae reddish black; mesepisterna with punctures as large as those of scutum and slightly separated. Abdomen shiny, punctures finer than those of vertex, those of anterior tergites dorsally separated by about their diameters, those of sides of abdomen and of posterior tergites closer; posterior margins of tergites one to four with pubescent bands; lateral teeth of sixth tergite subacute, about as broad as long; median teeth long conical, broadened basally, narrow apically, longer than basal width, emargination between them longer than a semicircle. Length a little over 5 mm.

Type: Male; Chichenitza, Yucatan, Mexico, in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

Ashmeadiella (Ashmeadiella) californica californica (Ashmead)

Chalcodoma californica Ashmead, 1897, Proc. So. Calif. Acad. Sci., **1**(no. 3):1, ♂ ♀; Davidson, 1897, Proc. So. Calif. Acad. Sci., **1**(no. 3):1(habits).

Ashmeadiella californica Cockerell, 1903, Psyche, **10**:76 (list); Cockerell, 1922, Ann. Mag. Nat. Hist., (9)**10**:546.

Ashmeadiella californica californica Michener, 1936, Am. Mus. Nov., **875**:10, ♂ ♀.

Ashmeadiella coquilletti Titus, 1904, Proc. Ent. Soc. Wash., **6**:99, ♀ ♂; Michener, 1936, Am. Mus. Nov., **875**:5, ♀.

Ashmeadiella crassa Cockerell (misidentification), 1925, Proc. Calif. Acad. Sci., (4)**14**:207, ♀.

This is a conspicuously variable, large headed, robust, black species. The pubescence is commonly somewhat ochraceous. The tegulae are more strongly punctate than in most other species except *curriei* and *cactorum astragali.*

Female: Eyes slightly convergent toward clypeus; flagellum dusky beneath;

truncation of clypeus weakly concave, as long as distance from end of truncation to lateral angle of clypeus; clypeus rather coarsely and closely punctate, more finely so anteriorly, apical margin narrowly shiny and impunctate; cheeks as wide as or a little wider than eyes, seen from side; mandibles with distance from first to third tooth nearly as great as greatest width of eye, about as great as length of last three antennal segments together; punctures of vertex about same size as those of clypeus, often separated by a little shiny ground; punctures of frons fine and close, sometimes markedly different from those of vertex, as are those of ocellar triangle; anterior ocellus about on midpoint between antennal bases and posterior edge of vertex, though varying slightly in either direction; distance between posterior ocelli equal to distance to nearest eye margin, slightly less than distance to edge of vertex. Scutum without pair of pubescent spots anteriorly, punctures, except anteriorly, a little coarser and more distinctly separated than those of vertex; wings slightly grayish; hind tibial spurs finely serrate on both margins, inner margin of inner spurs more finely so and with shorter teeth than other margin. Abdominal punctures strong, those of dorsum of second tergite separated by less than their diameters; tergites one to five with apical bands of pale pubescence; scopa whitish. Length 5½ to 7½ mm.

Male: Similar to female. Inner margins of eyes converging toward clypeus; apex of clypeus with evident concavity, shorter than base of clypeus, demarked by distinct angles at its ends; cheeks a little narrower than or as wide as eyes, seen from side; anterior ocellus only a little posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli as great as or greater than distance to nearest eye margin, and less than distance to posterior edge of vertex; lateral teeth of sixth tergite large and acutely pointed; median teeth long, broadened basally, concavity between them much longer than a semicircle. Punctation similar to that of female but somewhat finer, especially on clypeus; punctures between ocelli not finer than elsewhere on vertex; punctures of mesepisterna almost as large as those of vertex; punctures of abdomen coarser and closer than in female. Length 5½ to 7 mm.

This form is widely distributed and abundant in the Pacific coast region, though apparently absent from the deserts and replaced in the Sierra Nevada Mountains of California by another subspecies.

BRITISH COLUMBIA: Summerland, August 10, 1916 (F. W. L. Sladen, Canadian Nat. Coll.). UTAH: Kaibab Plateau, 9000 feet, June 29, 1928 (W. H. Thorpe). WASHINGTON: Stratford, July 4, 1920 (R. S. Shannon); Wawawai, July 12, 1925 (C. L. Fox, Calif. Acad. Sci.) OREGON: Mt. Hood, 3000 to 6000 feet, August 6 to 19, 1925 (C. L. Fox); Eagle Ridge, Klamath Lake, June 14, 1924 (C. L. Fox) (both Calif. Acad. Sci.); Whitewater Ridge, Mt. Jefferson, August 4, 1907 (J. C. Bridewell); Corvallis, July 17, 1910 (J. C. Bridwell) both U. S. N. M.); Pole Bridge Meadows, Crater Lake Park, 5900 feet elevation, August 11, 1935 (G. Ferguson); Sparks Lake, Deschutas County, 5428 feet elevation, August 8, 1935 (H. A. Scullen); Antilope Mountain, Harney County, 6500 feet elevation, August 12, 1931 (O. K. Frewing); Lakeview, 4800 feet elevation, July 27, 1930 (H. A. Scullen); Chemult, 4700 feet elevation, August 10, 1935 (G. Ferguson). CALIFORNIA: Clipper, Amador County, June 5, 1930 (E. C. Van Dyke); Blue Lakes, Lake Caunty, May 16, 1922 (E. P. Van Duzee); Davis Creek, Modoc County, July 13, 1922 (C. L. Fox);

Mokelumne Hill, September 6, 1896 (F. E. Blaisdell) (all Calif. Acad. Sci.); LaJolla, August 14, 1911 (J. C. Bridwell); Palo Alto; Santa Monica, August 15, 1935 (E. G. Linsley); Mt. Diablo, June 14, 1933 (R. M. Bohart); Mariposa County, July 2, 1933 (G. E. Bohart); Friant, May 24, 1936 (M. Cazier); Cisco, June 18, 1936 (A. R. Mead); Stanislaus County, August to September (J. G. Grundel); Hastings Natural History Reservation, Jamesburg, Santa Lucia Mountains, Monterey County, May 21 to June 1, 1938 (C. D. Michener); Bass Lake, Madera County, June 6, 1938 (R. M. Bohart); Sunset Valley, Santa Barbara County, July 14, 1938 (M. Cazier); Summit Lake, Mount Lassen, 6700 feet elevation, July 21 to 22, 1937 (F. X. Williams); above Vernal Falls, Yosemite, June 27, 1926, on *Aster yosemitensis;* Santa Maria, August 15, 1936, on *Hemizonia;* Coffee Camp, June 25, 1923, on *Senecio douglasii;* Big Pines Camp, June 17, 1927, on *Erigeron stenophyllus;* Swartout Valley, June 3, 1928, on*Phacelia davidsoni;* Tetley Park, San Bernardino Mountains, May 23, 1936, on *Potentilla glandulosa;* Riverside, April 11 to November 1, on *Eriogonum fasciculatum, Lotus americanus, Cryptantha intermedia, Gilia multicaulis, Hugelia virgata, Gutierrezia californica, Hemizonia, Encelia farinosa, Erigeron stenophyllus, Heterotheca grandiflora, Stephanomeria exigua;* the Gavilan, June 21, 1938, on *Hugelia virgata;* Whittier, August 13, 1920; Puente Hills, May 11; Idyllwild, July 22, 1935; five miles north of Warner Springs, September 22, 1938 (all P. H. Timberlake). LOWER CALIFORNIA: Twelve miles north of Ensenada, August 1, 1934, on *Isocoma* (P. H. Timberlake).

Type: Female; from near Los Angeles, California, in the United States National Museum.

Ashmeadiella coquilletti Titus appears to be based on unusually large specimens of *californica californica.* Slight differences in puncturation which might appear to separate them break down when long series are studied. As is often the case in other species, large examples have proportionately larger heads, broader cheeks, and more lengthened vertices than small ones.

Ashmeadiella (Ashmeadiella) californica florissantensis (Michener)

Ashmeadiella florissantensis Michener, 1936, Pan-Pac. Ent., **12**:62, ♂ ♀.

Ashmeadiella californica florissantensis Michener, 1936, Am. Mus. Nov., **875**:11.

Ashmeadiella cactorum Cockerell (misidentification), 1910, Univ. Colo. Stud., **7**:192 (key).

This is a very weakly differentiated subspecies, differing from typical *californica* in the female by the coarser punctures of the upper part of the clypeus, which are distinctly separated by shiny surface. Males of the two forms are nearly indistinguishable. Certain Colorado females are indistinguishable from Californian specimens.

This form is probably found throughout most of the Rocky Mountain region.

WYOMING: Southeastern, August 8, 1937 (C. D. Michener). COLORADO: Troublesome, 7345 feet elevation, June 9, 1908 (S. A. Rohwer); Willow Creek, Custer County (T. D. A. Cockerell, collection W. H. Ashmead, U.S.N.M.) NEW MEXICO: Beulah, June 29, 1902 (Acad. Nat. Sci. Phila.)

Type: Male; Florissant, Colorado, in Cockerell collection at Boulder, Colorado.

Ashmeadiella (Ashmeadiella) californica sierraensis subsp. nov.

Female: Similar to typical *californica* but punctures of abdomen fine and sparse, those of dorsum of second tergite minute and separated by several times their diameters; distance between posterior ocelli less than distance from posterior ocellus to eye margin.

Male: Perhaps a little more finely punctate than in *californica*.

This subspecies occupies the higher parts of the Sierra Nevada Mountains.

Holotype female (Calif. Acad. Sci., Ent. No. 4733), Giant Forest (Sequoia National Park), Tulare County, California, July 18, 1923 (C. L. Fox). Paratypes (all females) are from the following localities in California: one from Mineral King, Tulare County, September 3, 1933, on *Aster* (C. D. Michener); two, same locality, August 1 to 2, 1935 (G. E. Bohart); one, Tokopah Valley, Sequoia National Park, August 26, 1933, on *Aster adscendens* (C. D. Michener); two, Mammoth Lakes, Mono County, July 24 and 25, 1936 (G. E. and R. M. Bohart); Huntington Lake, Fresno County, 7000 feet elevation, July 12 (E. P. VanDuzee); Rock Creek Lakes, Inyo County, 9700 feet elevation, July 9, 1934 (G. E. Bohart); Truckee, June 17, 1927 (E. P. VanDuzee.)

Considering distribution, it seems strange that this subspecies should be more distinct from typical *californica* than is *florissantensis*.

Ashmeadiella (Ashmeadiella) opuntiae (Cockerell)

Heriades opuntiae Cockerell, 1897, Ann. Mag. Nat. Hist., (6)**20**:139, ♀.

Eriades opuntiae Friese, 1911, Das Tierreich, **28**:29, ♀.

Ashmeadiella opuntiae Cockerell, 1897, Ent. News, **8**:197; Cockerell, 1898, Bull. Denison Univ., **11**:64 (key); Cockerell, 1898, Bull. Univ. New Mex., **1**:64 (key); Cockerell, 1900, Am. Nat., **34**:488 (record); Michener, 1936, Am. Mus. Nov., **875**:4, ♂.

Ashmeadiella submaxima Michener, 1936, Am. Mus. Nov., **875**:3, ♂.

This species is large, robust, black, and rather sparsely pubescent. The broad mandibles and long clypeal truncation seem to indicate a relationship with *Titusella*.

Female: Transfacial line about as long as facial; inner margins of eyes harly converging below; under side of flagellum dusky or brown; truncation of clypeus longer than distance from end of truncation to lateral angle of clypeus; truncation demarked laterally by distinct, slightly produced angles, so that truncation is somewhat concave; anterior fourth of clypeus, except for the smooth margin, finely and closely punctate; disk of clypeus with punctures coarse and separated by about their diameters to nearly twice their diameters; anterior ocellus at or near midpoint between antennal bases and posterior edge of vertex; cheeks as broad as or a little broader than eyes, seen from side; mandibles with distance from first to third tooth about as long as greatest width of eye, longer than length of last three antennal segments together; dorsal carina of anterior edge of mandibles ending nearer anterior basal angle

than posterior basal angle of mandible; distance between posterior ocelli less than distance to nearest eye margin, which distance is less than distance to posterior edge of vertex; punctures of head except clypeus and of thorax finer than those of disc of clypeus and rather close, those of vertex a little coarser than those of scutum; no pair of hair spots at anterior end of scutum; punctures of mesepisterna slightly finer than those of scutum; tegulae piceous; claw segments of tarsi slightly rufescent; inner margin of inner hind tibial spurs finely serrate with about eighteen small teeth, outer margin with about seven teeth, the median ones of which are long and slender; inner and outer margins of outer spurs with about six and eight somewhat oblique teeth respectively; abdomen strongly punctured; apical pubescent band of fifth tergite usually distinct, sometimes weakened or apparently absent (perhaps worn); scopa white. Length 8 mm.

Male: Similar to female. Transfacial line longer than facial; inner margins of eyes with lower parts diverging toward clypeus; anterior margin of clypeus with broad, shallow emargination, a little shorter than basal width of clypeus, delimited laterally merely by a broad, rounded angle on each side; cheeks as wide as eyes or nearly so. Inner margin of inner hind tibial spurs finely serrate, outer margin with a few coarse teeth; inner margin of outer spurs with two low, oblique teeth, outer margin with about six, small, inconspicuous, oblique teeth. Sixth tergite with lateral teeth long, pointed apically; median teeth over twice as long as basal width, concavity between them considerably longer than semicircle. Punctation similar to that of female, but punctures of vertex a little coarser, those of disc of clypeus finer; subapical finely punctate band of clypeus narrower; clypeus and supraclypeal area not densely covered with hair, as in many males; fifth tergite without apical pubescent band. Length 7 to 9 mm.

This is a species of the arid regions from Texas and southern Colorado to California and Sonora, and is apparently an oligotropic visitor of the flowers of cactus.

TEXAS: Cotulla, on *Opuntia*, May 10, 1906 (J. C. Crawford, U. S. N. M.) ARIZONA: Santa Rita Mountains, August 18, 1935 (E. I. Beamer, Univ. of Kansas). SONORA: Rio Mayo, July 10, 1935 (Bohart collection). CALIFORNIA: Cathedral City, Riverside County, on *Echinocactus cylindraceus* (E. G. Linsley, C. D. Michener); Palm Springs, April 2, 1937, on *Opuntia echinocarpa;* San Felipe Creek, June 5, 1936, on *Opuntia megacarpa;* Riverside, April 24, 1934, on *Opuntia vaseyi;* Whittier, March 13, 1926, on *Opuntia;* Clark Mountains, 4500 feet elevation, on *Vigueria nevadensis* (all P. H. Timberlake); Willow Springs, Kern County.

Type: Female; Soledad Canyon, Organ Mountains, New Mexico.

Most Californian specimens have the anterior ocellus farther posterior than in specimens from the eastern part of the range. A possible subspecific separation is thus suggested.

Ashmeadiella (Ashmeadiella) arizonensis Michener

Ashmeadiella arizonensis Michener, 1936, Am. Mus. Nov., **875**:3, ♂.

This species is similar to *opuntiae*, of which it may be a synonym. It

differs, however, by the somewhat narrower and deeper median, apical, clypeal, emargination, more finely punctured scutum as compared with abdomen and vertex, as well as by smaller size and other minor characters.

Male: Inner margins of eyes slightly converging below, their lower ends diverging; facial line shorter than transfacial; mandibles each with transverse red band; cheeks distinctly narrower than eyes, seen from side; median ocellus near midpoint between bases of antennae and posterior edge of vertex; distance between posterior ocelli slightly less than distance to eye, distinctly less than distance to posterior edge of vertex; frons and vertex densely punctate. Scutum without pubescent spots anteriorly, considerably more finely punctate than vertex; mesepisterna punctured about as vertex; legs dark brown, apical tarsal segments reddish; wings clear. Abdominal tergites with punctures larger than those of scutum, separated on dorsum of anterior tergites, close laterally and on posterior tergites; median teeth of sixth tergite about twice as long as broad; tergites one to four with apical bands of white pubescence; extreme sides of tergites and posterior margins of anterior tergites narrowly brown. Length 7 mm.

Type: Male; Kits Peak, Rincon, Baboquivari Mountains, Arizona, in the American Museum of Natural History. The species is known only from the unique type.

Ashmeadiella (Ashmeadiella) stevensi Michener

Ashmeadiella stevensi Michener, 1937, Ann. Mag. Nat. Hist., (10)**19**:405, ♀.

This is a rather large, black species, easily recognized by the rather elongate head, polished and sparsely punctate upper part of clypeus, and the divergent inner orbits.

Female: Facial line considerably longer than transfacial; inner margins of eyes slightly divergent below; upper two-thirds of clypeus shiny, punctures widely separated; anterior part of clypeus dull and closely punctate; supraclypeal area closely punctate and rather dull; cheeks more finely punctate than mesepisterna; anterior ocellus slightly nearer posterior edge of vertex than antennal bases; scutum without pair of pubescent spots anteriorly; punctures of mesepisterna slightly smaller than those of scutum; claw segments of tarsi rufescent; tegulae with reddish spot; wings nearly clear. Punctures of tergites one to three finer than those of scutum, close laterally, fine medially; punctures of tergites four to six as large as those of scutum and approximate or nearly so; scopa white. Length 7 mm.

Type: Female; Bowman, North Dakota, in the collection of Prof. O. A. Stevens, who states that it will be sent to the United States National Museum. The species is known only from the unique type, which was collected on flowers of *Opuntia*.

Subgenus TITUSELLA Cockerell

Titusella Cockerell, 1906, Bull. Am. Mus. Nat. Hist., **22**:445; Cockerell, 1910, Univ. Colo. Stud., **7**:185; Michener, 1936, Am. Mus. Nov., **875**:1.

This subgenus consists of rather large, large headed, black species. To judge by the narrow lateral teeth of the sixth tergite of the male and the brushes under the anterior margin of the clypeus of the female and the hind tibial spurs, the group is most closely related to *Ashmeadiella* s.str., from which it differs by the broad mandibles of the female, which have from four to six teeth.

Female: Mandibles more than twice as long as scape, broad, with from four to six teeth, inner ones low and weak; labrum short, apex rounded truncate or bilobate; distance from first mandibular tooth to inner apical angle of mandibles more than half length of mandible; apical margin of clypeus, beneath which is a pair of orange brushes, somewhat thickened, not produced beyond line between lower ends of eyes, but produced well over base of labrum; gular groove not greatly narrowed posteriorly; hypostomal carinae elevated posteriorly; hind tibial spurs with many fine, close teeth.

Male: Mandibles bidentate, inner margin basad to inner tooth not expanded; gular groove and hind tibial spurs as described above; lateral margins of sixth tergite slightly sinuate, not strongly convex; lateral teeth of sixth tergite rather slender.

Orthotype: *Titusella pronitens* Cockerell.

Titusella has previously been regarded as a distinct genus, but the discovery of the male and of a species approaching *Ashmeadiella* s.str. shows that it is best placed as a subgenus of *Ashmeadiella*.

Key to the Species of Titusella

FEMALES

1. Anterior margin of clypeus, between sublateral angles, broadly, shallowly, and evenly concave; clypeus punctured throughout; cheeks narrower than eyes seen from sides. ..... *biscopula*

   Anterior margin of clypeus not shallowly and evenly concave between sublateral angles; clypeus impunctate or nearly so medially; cheeks wider than eyes seen from side. 2

2(1). Apical tooth of mandibles with distinct inner basal lobe, giving a five-toothed aspect. ..... *pronitens*

   Apical tooth of mandible simple, mandible four-toothed. 3

3(2). Median apical emargination of clypeus deep; distance from first to forth tooth of mandibles equal to distance from fourth tooth to bas of mandibles. ..... *cubiceps cubiceps*

   Median apical emargination of clypeus shallow; distance from first to fourth tooth of mandibles less than distance from fourth tooth to base of mandibles. ..... *cubiceps clypeata*

MALES

Known only in *cubiceps clypeata*.

Ashmeadiella (Titusella) biscopula sp. nov.

This is a large, black, rather sparsely pubescent species, having the aspect of a moderate sized specimen of *bucconis denticulata*. It differs from other species of *Titusella* by the punctured clypeus, the anterior margin of which is broadly and shallowly concave.

Female: Transfacial line longer than facial; inner margins of eyes slightly converging below except for lower parts where they diverge; sides of faces densely covered with white hair; clypeus closely punctate laterally, coarsely and sparsely punctate medially; anterior margin of clypeus with broad, shallow, smooth margined concavity, the ends of which are marked by distinct, somewhat produced angles; arising beneath anterior margin of clypeus are two orange brushes, occupying the entire width of emargination; labrum bilobed at apex, most of its surface very sparsely punctate, shiny, finely lineolate; mandible with orange hairs just basad to teeth on outer sides; distance from first mandibular tooth to inner apical angle greater than distance from inner apical angle to base of mandible; mandibles with long apical tooth and distinct subapical tooth; remaining teeth inconspicuous, rounded elevations on a long, essentially straight margin, which is at an acute angle with the apical part of the inner margin of the mandible; cheeks nearly as broad as eyes seen from side; anterior ocellus somewhat posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli less than distance to posterior edge of vertex; vertex rather finely and closely punctured. Scutum without pair of spots of hair anteriorly, punctured like more coarsely punctate parts of vertex; scutellum more sparsely punctate than scutum; mesepisterna slightly more sparsely punctate than scutum; wings grayish; inner margin of inner hind tibial spurs finely serrate with about seventeen small teeth, outer margin with about eight larger teeth; outer spurs with about eight or nine teeth on each margin, those of inner margin larger and slightly fewer than those of outer. Abdominal tergites one to three finely and sparsely punctate dorsally, except for posterior margins which are closely punctate; tergites four to six, and tergites one to three laterally, closely punctate; tergites one to four with distinct, apical bands of white pubescence; scopa dull white. Length 6½ mm.

Holotype and one paratype: Apache Camp, Santa Catalina Mountains, Arizona, 5500 feet elevation, July 25, 1917 (J. Bequaert collection, Museum of Comparative Zoology, Cambridge, Massachusetts).

Ashmeadiella (Titusella) cubiceps cubiceps (Cresson)

Heriades (?) *cubiceps* Cresson, 1879, Trans. Am. Ent. Soc., **7**:205, ♀; Schletterer, 1889, Zool. Jahrb., Abt. f. Syst., Geog. u. Biol. **4**:682, ♀; Cresson, 1916, Mem. Am. Ent. Soc., **1**:116, ♀.

Eriades cubiceps Dalla Torre, 1896, Cat. Hymen., **10**:375, ♀; Friese, 1911, Das Tierreich, **28**:25, ♀.

Titusella cubiceps Cockerell, 1908, Ann. Mag. Nat. Hist., (8)**2**:331; Michener, 1936, Am. Mus. Nov., **875**:13, ♀.

This rather variable, black, sparsely punctate species has a large quadrate head and broad quadridentate mandibles in the female.

Female: Inner margins of eyes diverging below; under side of flagellum brown; clypeus impunctate except laterally, anterior margin with median emargination; mandibles with distance from first tooth to inner apical angle (fourth tooth) equal to distance from inner apical angle to base; angle

between line drawn from third to fourth mandibular tooth and inner margin of mandibles about 130°; cheeks much wider than eyes, seen from sides; lower part of supraclypeal area smooth; frons and vertex rather closely punctate; anterior ocellus near midpoint between antennal bases and posterior margin of vertex; distance between posterior ocelli equal to distance to eye, less than distance to posterior margin of vertex. Scutum a little more coarsely and less closely punctate than vertex; tegulae brownish; wings slightly dusky; mesepisternum slightly more finely punctate than scutum; hind tibial spurs about as in the preceding species except that the outer margin of the inner spur has about twelve teeth. Abdomen finely punctate, punctures of dorsum of first three tergites separated by more than their diameters; scopa dull white. Length 7 mm.

This species occurs in "Nevada" and in the higher Sierra Nevada of California.

CALIFORNIA: Gold Lake, Sierra County, July 25, 1921 (C. L. Fox, Calif. Acad. Sci.); Mt. Lassen, 6700 feet, July 21 and 22, 1937 (F. X. Williams); Monanche Meadows, Tulare County, July 26, 1935 (W. Evans); Agnew Meadows, Madera County, July 30, 1936 (G. E. & R. M. Bohart). One of the specimens from the latter locality approaches *clypeata*. Specimens from twenty-five miles east of Prineville, OREGON, 3800 feet, July 13, 1936 (H. A. Scullen) and Antelope Mountain, Harney County, Oregon, August 2, 1931 (D. K. Frewing) are perhaps best placed in typical *cubiceps*, but approach *clypeata*.

Type: Female; from Nevada, in the collection of the Academy of Natural Sciences of Philadelphia. It seems likely that the type is from western Nevada, in the mountains near the Californian border.

Ashmeadiella (Titusella) cubiceps clypeata (Michener)

Titusella clypeata Michener, 1936, Am. Mus. Nov., **875**:13, ♀; Michener, 1936, Bull. So. Calif. Acad. Sci., **35**:93, ♀; Michener, 1937, Ann. Mag. Nat. Hist., (10)**19**:406.

Female: Similar to typical *cubiceps* but anterior median clypeal emargination shallow; mandibles with distance from first to fourth tooth less than distance from fourth tooth to base, angle between line drawn from third to fourth tooth and inner edge of mandibles about 100°. Punctures of abdomen coarser, not widely separated. Length 5½ to nearly 8 mm.

Male: Coloration and pubescence similar to female. Face densely covered with white pubescence; inner orbits slightly converging toward clypeus except for lower ends; anterior margin of clypeus with short concave space, demarked by distinct angle at each side; cheeks narrower than eyes, seen from sides; anterior ocellus at midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli about equal to distance to eye and slightly less than distance to posterior margin of vertex; vertex rather coarsely punctate. Scutum similarly punctured posteriorly, more finely so anteriorly, without distinct pair of hair tufts anteriorly; mesepisterna a little more finely punctured than vertex; tegulae piceous. Punctures of abdomen rather fine and not widely separated, finer than those of posterior part of scutum; median

teeth of sixth tergite about as broad as long, divergent, concavity between them slightly broader than semicircle; tergites one to five with apical bands of white pubescence. Length 5 mm.

This subspecies has as yet been collected only in California. It appears to occur at lower elevations than *cubiceps cubiceps*, and in its typical form occurs in southern California and northward in the region west of the mountains, although specimens which are nearly typical *clypeata* occur in the arid regions east of the Sierra Nevada. New localities for typical *clypeata* are as follows:

CALIFORNIA: Visitacion Valley, San Mateo County, June 4, 1923 (C. L. Fox, Calif. Acad. Sci.); Little Rock, April 11, 1936 (G. E. & R. M. Bohart); Mint Canyon, Los Angeles County, May 3, 1936, on *Cryptantha* (E. G. Linsley); Riverside, on *Chaenactis*, May 5, 1937 (P. H. Timberlake).

Specimens which are nearly typical *clypeata*, but some of which show some approach to *cubiceps* are from Dead Mans Creek, Mono County, July 28, 1936 and Mammoth, July 19, 1933 (G. E. & R. M. Bohart) and Truckee, July 4, 1927 (E. P. Van Duzee, Calif. Acad. Sci.).

A single very small female from west side of Westgard Pass, Inyo County, California, June 15, 1937 and a normal sized female from Lone Pine, Inyo County, May 24, 1937 (E. C. Van Dyke) have the clypeus largely punctate, but its margin as in *clypeata*, of which they are probably only variants.

Type: Female; Eagle Rock Hills, Los Angeles County, California, on loan to the California Academy of Sciences.

Ashmeadiella (Titusella) pronitens (Cockerell)

Titusella pronitens Cockerell, 1906, Bull. Am. Mus. Nat. Hist., **22**:446, ♀; Cockerell, 1908, Ann. Mag. Nat. Hist., (8)**2**:331 (record); Cockerell, 1910, Univ. Colo. Stud., **7**:191; Cockerell, 1919, Ann. Mag. Nat. Hist.; (9)**4**:358 (record); Cockerell, 1928, Univ. Colo. Stud., **16**:115 (record); Cockerell, 1933, Ann. Ent. Soc. Am., **26**:44 (record).

This species has the aspect and to a large degree the structure of *cubiceps*, to which it is closely related, differing primarily in the presence of a large lobe between the first and second mandibular teeth.

Female: Inner margins of eyes diverging toward clypeus; under side of flagellum dusky; clypeus impunctate except laterally, anterior margin with median emargination; mandibles with distance from first tooth to inner apical angle greater than distance from inner apical angle to base; angle between line drawn from third to fourth mandibular tooth and inner margin of mandibles about 135°; first mandibular tooth broadened basally on inner side into a rounded lobe, forming a distinct fifth tooth; cheeks much wider than eyes seen from side; supraclypeal area largely impunctate; frons and vertex closely punctate, posterior half of vertex more coarsely and less closely punctate than anterior part; anterior ocellus slightly anterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli less than distance to eye, much less than distance to posterior edge of vertex. Scutum, except anteriorly, punctured like posterior part of vertex; tegulae dark brown; wings slightly dusky; both margins of inner hind tibial spur with about seven-

teen small, rather long teeth; inner margin of outer spur with about eight low, oblique teeth, outer margin with about ten similar teeth; mesepisterna slightly more finely punctate than scutum. Abdomen finely punctate, punctures of dorsum of tergites one to three so fine and sparse as to be inconspicuous. Scopa yellowish white. Length 6½ to 8 mm.

This species occurs in the higher mountains of Colorado.

Type: Female; Florissant, Colorado, in the Cockerell collection at Boulder, Colorado.

Although in 1936 I considered this species a synonym of *cubiceps*, it now appears that it is distinct on the basis of the mandibular characters mentioned above. It may be only a subspecies of *cubiceps*, however, since morphologically it seems no more distinct from it than *clypeata*, which intergrades with *cubiceps*.

Subgenus **Arogochila** subg. nov.

This subgenus comprises a group of species in which the clypeus of the female is often greatly produced, lobate, or otherwise modified. The head, however, is rarely large in size. *Arogochila* and its ally, *Corythochila*, differ from *Ashmeadiella* s.str. and *Titusella* in the absence or reduction of the brushes of orange hair under the margin of the clypeus of the female, and in the broad lateral teeth of the sixth tergite of the male. *Arogochila* differs from *Corythochila* by the usually tridentate mandibles and the more produced clypeus of the female.

Female: Mandibles more than twice as long as scape, tridentate (rarely quadridentate); gular groove not much narrowed posteriorly; clypeus produced well over base of labrum, apex variously lobate, without or with inconspicuous orange brushes beneath the margin; hind tibial spurs with rather few to fairly numerous small teeth.

Male: Mandibles bidentate, inner margin just basad to inner tooth swollen; hypostomal carinae not elevated behind; lateral margins of sixth tergite convex; lateral teeth of sixth tergite broad, apices not very acute.

Type: *Ashmeadiella timberlakei* Michener.

Key to the Species of Arogochila

FEMALES

1.— Median lobe of apical margin of clypeus inconspicuous, several or many times as broad as long, broadly truncate 2

—. Median lobe of apical margin of clypeus conspicuous, not over three times as broad as long, not broadly truncate 3

2(1). Lateral lobes of clypeus acute, exceeding median lobe; abdomen black.— ..... *sculleni*

—. Lateral lobes of clypeus mere rounded angles, exceeded by median lobe; abdomen partly red. ..... *barberi*

3(1). Notches separating median from lateral lobes of clypeus deep, nearly parallel sided (if more or less V-shaped, deeper than broad); median lobe of clypeus broad, narrower basally than subapically or medially 4

—. Notches separating median from lateral lobes of clypeus variable, V-shaped, or if nearly parallel sided, then several times as broad as deep, sometimes nearly wanting; median lobe of clypeus broadest basally, tapering apically (except in *erema*) 7

4(3). Apical part of median lobe of clypeus elongated so that lobe is widest in the middle; abdomen red ..... *eurynorhyncha*

—. Apical part of median lobe of clypeus short, so that lobe is widest subapically; abdomen not all red 5

5(4). Median lobe of clypeus entire at apex; lateral lobes low and rounded; abdomen black ..... *neomexicana*

—. Median lobe of clypeus emarginate or notched 6

6(5). Emargination of median lobe of clypeus broad and shallow; lateral lobes of clypeus rounded; abdomen black ..... *clypeodentata*

—. Emargination of median lobe of clypeus deep and narrow; lateral lobes of clypeus acutely pointed; abdomen red laterally ..... *stenognatha*

7(3). Line drawn between apices of lateral lobes of clypeus crosses median lobe in its apical half; median lobe notched at apex 8

—. Median lobe of clypeus larger and lateral lobes smaller, so that line drawn between their apices cuts median lobe in basal half; median lobe not or but weakly notched at apex 10

8(7). Median lobe of clypeus broader than long 9

—. Median lobe of clypeus as long as broad or nearly so ..... *lutzi*

9(8). Median of clypeus somewhat over twice as broad as long. ..... *timberlakei solida*

—. Median lobe of clypeus nearly three times as broad as long. ..... *timberlakei timberlakei*

10(7). Median lobe of clypeus slightly narrower basally than subapically, its margin rather irregular ..... *erema*

—. Median lobe of clypeus tapering toward apex 11

11(10). Median lobe of clypeus directed foreward, so that in profile its upper side is nearly at right angles to the adjacent disc of clypeus ..... *salviae*

—. Median lobe of clypeus with upper side at an obtuse angle to adjacent disc of clypeus 12

12(11). Apex of labrum with two teeth, the apices of which are separated by a distance about equal to width of mandible at narrowest part; median lobe of clypeus large, its margin irregular ..... *australis*

—. Apex of labrum tapering to a notched or narrowly truncate apex, less than half as broad as width of mandible at narrowest part; median lobe of clypeus smaller, its margin not irregular ..... *cazieri*

MALES

1. Teeth of sixth tergite low and rounded; lateral ones with apex a very obtuse angle, median ones generally much broader than long; abdomen red, or tergites with small black areas medially ..... *eurynorhyncha*

—. Teeth of sixth tergite longer, lateral ones apical angle usually about a right angle, median ones generally longer than broad; abdomen with much more black 2

2(1). Median teeth of sixth tergite twice as long as broad; anterior margin of clypeus not emarginate medially ..... *australis*

—. Median teeth of sixth tergite much less than twice as long as broad 3

3(2). Punctures of clypeus coarse and rather widely separated; anterior margin of clypeus not or hardly emarginate; abdomen black ..... *foxiella*

—. Punctures of clypeus fine and close, except for the thickened, shiny, impunctate, usually somewhat concave anterior margin 4

4(3). Distance between posterior ocelli considerably more than distance to nearest eye margin; cheeks little over half as wide as eyes, seen from side 5
—. Distance between posterior ocelli about equal to distance to nearest eye margin; cheeks much over half as wide as eyes, seen from side..... 8
5(4). Concavity of anterior margin of clypeus shorter than distance between antennae and delimited laterally by a distinct angle on each side..... 6
—. Concavity of margin of clypeus weak, broader than distance between antennae, and not distinctly delimited laterally by angles ..... *cazieri*
6(5). Abdomen black; clypeus covered with pubescence only laterally..... *clypeodentata*
—. Abdomen largely red; clypeus covered with white pubescence 7
7(6). Lower parts of cheeks and areas between eyes and lateral ocelli with punctures approximate or nearly so; hind tibial spurs strongly toothed.— ..... *(Corythochila) inyoensis*
—. Lower parts of cheeks and areas between eyes and lateral ocelli with punctures often rather widely separated; hind tibial spurs nearly edentate.— ..... (*Corythochila*) *breviceps*
8(4). Apex of clypeus only faintly and shallowly concave medially; posterior legs black ..... *salviae*
—. Apex of clypeus with distinct although shallow median emargination, bounded laterally by distinct angles; hind femora largely red..... 9
9(8). Punctures of posterior half of dorsum of second tergite separated by more than their diameters; red markings dark red; lateral teeth of sixth tergite black ..... *lateralis*
—. Punctures of posterior half of dorsum of second tergite separated by less than their diameters; red markings bright; lateral teeth of sixth tergite red.....10
10(9). Labrum distinctly emarginate apically ..... *timberlakei timberlakei*
—. Labrum but slightly emarginate apically ..... *timberlakei solida*

Ashmeadiella (Arogochila) sculleni sp. nov.

This black species is the largest in the subgenus. The median lobe of the clypeus is very short and broadly truncated, exceeded by the lateral lobes. *A. barberi* has a somewhat similar clypeus, although the lateral lobes are shorter than the median. That species, however, is much smaller than *sculleni* and has red markings on the abdomen.

Female: Inner margins of eyes diverging below; transfacial line longer than facial; flagellum dusky beneath; clypeus short and broad, trilobed, lateral lobes small, rather slender, bluntly pointed at apices, median lobe broad, truncated, shorter than lateral lobes; supraclypeal area and most of clypeus rather coarsely and not very closely punctate, anterior part of clypeus with smaller, somewhat elongate punctures; apical mandibular tooth brownish; third mandibular tooth represented by a beveled, rounded margin; labrum with apex emarginate, flattened dorsal surface smooth and polished; frons closely punctured; anterior ocellus posterior to midpoint between bases of antennae and posterior edge of vertex; distance between posterior ocelli equal to distance to eye margin and slightly less than distance to posterior edge of vertex; vertex closely punctate, a little more closely so than frons; punctures of cheeks as large as those of frons, separated by a little shiny surface; hypostomal carinae not produced to teeth posteriorly; cheeks nearly as wide as eyes seen from side. Scutum without pair of hair tufts anteriorly, a little more coarsely punctate than vertex, punctures separated by a little shiny surface; mesepisterna

similarly punctured; tegulae brownish; inner margin of inner hind tibial spurs finely serrate with over fifteen small, oblique teeth, outer margin with about eight larger, oblique teeth; outer margin of outer hind tibial spurs with about seven small, very oblique teeth, inner margin with five or six somewhat larger, oblique teeth. Concavity at base of first tergite shallow, and its bounding carina weak, for an *Ashmeadiella;* first four abdominal tergites very finely punctate, punctures separated by more than their diameters; fifth and sixth tergites closely and a little more coarsely punctate; tergites one to five with apical bands of pubescence; scopa dull white. Length 9 mm.

Holotype (Calif. Acad. Sci., Ent. No. 4734) and one paratype: Burns, Oregon, elevation 4150 feet, July 2, 1927 (H. A. Scullen, Ore. Exp. Sta. Acc. 3710). This species is named for Prof. H. A. Scullen, who has kindly agreed to the placement of the holotype in the California Academy of Sciences. The paratype has been returned to him.

Ashmeadiella (Arogochila) barberi sp. nov.

This is a black, sparsely pubescent species, with the sides of the abdomen broadly red. It differs from the several superficially similar species, such as *timberlakei,* by the unproduced clypeus, the median lobe of the apical margin of which is short and broadly truncated, but little exceeding the reduced lateral lobes. This is the only species of its subgenus in which the mandibles are quadridentate, in which character it resembles *Corythochila,* to which it might be referred. The mandibular teeth are lower than in *Corythochila,* however.

Female: Facial line much longer than transfacial; inner margins of eyes parallel; clypeus coarsely and not closely punctured, punctures arranged in indefinite longitudinal rows; apex of clypeus with a pair of rather broad, shallow, sublateral emarginations, which differentiate a short, broadly truncated median lobe from the rounded lateral lobes which are slightly (or considerably in some paratypes) exceeded by the median lobe; labrum with flattened portion of upper surface polished, apex shallowly emarginate; mandibles quadridentate, the two inner teeth low and rounded; hypostomal carinae not produced to teeth behind; cheeks nearly as broad as eyes, seen from side; supraclypeal area, frons, and vertex rather finely and closely punctured; flagellum brownish beneath; anterior ocellus much posterior to midpoint between bases of antennae and posterior edge of vertex; distance between posterior ocelli greater than distance to eye or to posterior edge of vertex; distance between posterior ocelli greater than distance to eye or to posterior edge of vertex. Scutum without spots of pubescence anteriorly, rather finely and closely punctate; scutellum more sparsely and a little more coarsely punctate than scutum; mesepisterna punctured similarly to scutellum; tegulae testaceous; wings slightly dusky; legs dark brownish; inner margin of inner hind tibial spurs finely serrate with about eleven small, oblique teeth, outer margin with about seven long teeth, basad to which are one or two small ones; outer spur with a few low, oblique teeth on each margin. Basal abdominal tergites dorsally with rather fine punctures, separated by less than their widths; punc-

tures larger and coarser on posterior tergites and on sides of tergites, where they are approximate; tergites one to five with lateral thirds and posterior margins red; sixth tergite red laterally; tergites one to four with weak apical bands of white pubescence; scopa yellowish white. Length 6 mm.

Holotype and three paratypes: Ashfork, Arizona, June 17 and 18 (Barber and Schwarz, U. S. N. M.) One paratype is in the author's collection.

Ashmeadiella (Arogochila) eurynorhyncha sp. nov.

In this small species the abdomen is largely or wholly red. It is probably most closely related to *stenognatha*, but the abdomen is redder and the apex of the median lobe of the clypeus is not or hardly notched.

Female: Inner margins of eyes slightly diverging below; facial line considerably longer than transfacial; under side of flagellum dusky; disc of clypeus shiny, with irreguar coarse punctures; median lobe of clypeus with strong longitudinal median carina which forks apically; notches separating median from lateral lobes of clypeus truncated, a little broader than deep, with sides only slightly diverging anteriorly; lateral lobes of clypeus small, sides at an acute angle with respect to one another but apex narrowly rounded; median lobe of clypeus large and broad, narrower at base than at middle, beyond middle tapering rapidly to the minutely emarginate apex; median lobe of clypeus, seen in profile, with upper margin at an angle of about 130° to adjacent disc of clypeus; labrum slightly broadened and shallowly emarginate at apex; hypostomal carinae each produced to a tooth behind; cheeks narrower than eyes, seen from side; anterior ocellus far posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli about equal to distance to nearest eye margin and to posterior edge of vertex; frons and vrtex closely punctate, frons more coarsely so than posterior part of vertex. Scutum and scutellum closely punctate, punctures aboue same size as those in ocellar region; mesepisterna with punctures separated by shiny surface; tegulae testaceous; wings clear; legs black; inner margin of inner hind tibial spurs finely serrate with about eleven small, oblique teeth, outer margin with about seven long teeth, basad to which are one or two small ones; outer hind tibial spurs with about four, low, very oblique teeth on each margin. Abdomen rather finely punctured, punctures of first two tergites dorsally separated by nearly their diameters; abdomen red; tergites one to five with apical bands of white pubescence; scopa white. Length nearly 5 mm.

Male: Facial line shorter than transfacial; inner margins of eyes converging slightly toward clypeus except for lower ends which diverge; under side of flagellum brown; clypeus with median part not covered with pubescence; clypeus coarsely punctured, punctures separated by shiny surface; center of clypeus with longitudinal impunctate line; apical margin of clypeus thickened and shiny, broadly, shallowly emarginate; mandibles reddish subapically; apex of labrum faintly emarginate medially; cheeks much narrower than eyes, seen from side; distance between posterior ocelli somewhat greater than distance

to nearest eye margin or to posterior edge of vertex; inner margin of inner hind tibial spur serrate with about eight small, oblique teeth, outer margin with six much larger, oblique teeth; both margins outer spur with four or five low, oblique teeth; punctation and coloration similar to female; pubescent bands of abdomen weak; sixth tergite with lateral teeth broadly rounded, exhibiting apical angle only weakly, median teeth broadly rounded, much broader than long (variable in paratypes, sometimes nearly as long as broad). Length nearly 5 mm.

Holotype female (Calif. Acad. Sci., Ent. No. 4735), allotype male (Calif. Acad. Sci., Ent. No. 4736), and seven paratypes: west of Lone Pine, Inyo County, California, 6500 feet elevation, May 19, 1937, on sand (C. D. Michener). One paratype from four miles west of Lone Pine, May 19, 1937 (C. D. Michener). Additional specimens are from Mazourka Canyon, Inyo Mountains, Inyo County, California, May 25, 1937, on *Parosela fremontii* (C. D. Michener) and Argus Mountains, Inyo County, Californai, May 28, 1937.

Ashmeadiella (Arogochila) stenognatha sp. nov.

This species is black with the abdomen partly red. It is probably most closely related to *eurynorhyncha*, but differs in having a shorter, broader face. The median lobe of the clypeus is broad, with a narrow median apical notch.

Female: Inner margins of eyes about parallel, diverging somewhat at lower ends; facial line but little longer than transfacial; clypeus punctate laterally, merely roughened on disc; notches separating median from lateral lobes of clypeus deeper than broad, with sides diverging but slightly apically; lateral lobes of clypeus small, slender, acutely pointed apically; median lobe of clypeus broad, narrower basally than subapically, apical margin broadly rounded, crenulate, with small, deep, median notch; median lobe of clypeus with longitudinal median carina; median lobe, seen from side, with dorsal surface at an angle of about 150° or more to surface of adjacent disc of clypeus; labrum bidentate at apex; mandibles slender; hypostomal carinae each produced to a tooth posteriorly; cheeks narrower than eyes, seen from sides; anterior ocellus posterior to midpoint between bases of antennae and posterior edge of vertex; distance between posterior ocelli equal to distance to nearest eye margin; frons and vertex rather finely and closely punctured. Scutum and scutellum with punctation similar to that of vertex; no pair of hair tufts at anterior end of scutum; mesepisterna more coarsely and less closely punctured than scutum; tegulae testaceous; wings faintly dusky; legs black; inner margin of inner hind tibial spurs serrate with about twelve small teeth, outer margin with four long teeth, basad to which are two or three not much smaller ones. Abdominal tergites strongly punctured; sides of tergites one to five rather dark red, posterior margins of these tergites also dark reddish; posterior margins of tergites one to five with inconspicuous apical pubescent bands. Length 6 mm.

Holotype: east side of Mt. Baldy, Panamint Mountains, Inyo County, California, 9000 feet elevation, June 18, 1937 (C. D. Michener).

Ashmeadiella (Arogochila) neomexicana (Cockerell)

Chelostoma Neomexicanum Cockerell, 1904, Can. Ent., **36**: 13, ♀.

This is a black, rather sparsely pubescent species. It resembles *clypeodentata* but differs by the non-emarginate apex of the median lobe of the clypeus.

Female: Inner margins of eyes diverging toward clypeus; clypeus coarsely, irregularly, and confluently punctured; notches separating median from lateral lobes of clypeus deeper than wide, with sides but slightly diverging apically; lateral lobes of clypeus short, rounded apically; median lobe of clypeus narrower basally than subapically, beyond widest part tapering rapidly to rounded apex; median lobe of clypeus with longitudinal dorsal carina; median lobe, seen in profile, with dorsal side at an angle of about 135° to adjacent disc of clypeus; labrum broad at apex and strongly emarginate; cheeks nearly as wide as eyes, seen from side; vertex closely and rather finely punctate; anterior ocellus posteroir to midpoint between bases of antennae and posterior edge of vertex; distance between posteriot ocelli equal to distance to nearest eye margin or to posterior edge of vertex. Scutum without pair of pubescent spots anteriorly, a little more coarsely and less closely punctate than vertex; mesepisterna with punctures a little smaller and closer than those of scutum. Abdomen more finely punctate than scutum, punctures of anterior tergites dorsally separated by about their diameters; tergites one to five with apical bands of white pubescence. Length 8 mm.

Type: Female; Barela Mesa, New Mexico, in the United States National Museum. Known only from the unique type.

This species has been confused with *Formicapis clypeata* Sladen, which has been referred to as *F. neomexicana* (Ckll.) The genus *Formicapis*, however, is quite distinct from *Ashmeadiella* (see Michener, 1938, Ent. News, 49:129).

Ashmeadiella (Arogochila) clypeodentata Michener

Ashmeadiella clypeodentata Michener, 1936, Pan-Pac. Ent., **12**: 57, ♀; Michener, 1936, Nov. Am .Mus., **875**: 12 (Key).
Ashmeadiella crassa Cockerell, 1924, Proc. Calif. Acad. Sci., **12**(4): 558, ♀ (part).

This black species is similar to *neomexicana* but smaller, with the median lobe of the clypeus emarginate at apex in the female.

Female: Inner margins of eyes diverging toward clypeus; flagellum dusky or brown beneath; clypeus coarsely punctate; notches separating median from lateral lobes of clypeus narrow and deep, their sides diverging somewhat apically; lateral lobes of clypeus low and rounded; median lobe short, with median emargination, giving, with the lateral apical angles of the lobe, a four-lobed aspect to the median lobe of clypeus; median lobe of clypeus with a longitudinal carina; median lobe, seen in profile, with upper face at an angle of nearly 170° to adjacent disc of clypeus; labrum with deep apical emargination; hypostomal carinae each produced to a tooth posteriorly; cheeks nearly as wide as eyes, seen from side; frons and vertex closely punctate; anterior

ocellus much posterior to midpoint between bases of antennae and posterior edge of vertex; distance between posterior ocelli slightly greater than distance to nearest eye margin or to posterior edge of vertex. Scutum and scutellum a little less closely punctate than vertex, scutum with a scarcely perceptable pair of pubescent spots anteriorly; mesepisterna a little more sparsely punctate than scutum; wings clear; inner margin of inner hind tibial spurs serrate with about ten small teeth; outer margin with seven long teeth, the distal one and the basal two of which are shorter than the others; inner margin of outer spurs with four small teeth, basal two largest, outer margin with six small, oblique teeth. Abdomen nearly as coarsely punctate as scutum, punctures close, or on anterior tergites dorsally separated by nearly half a puncture width; tergites one to five with distinct apical bands of white pubescence; scopa dull white, sparse. Length 6 to 7 mm.

Male: Similar to female; lower parts of inner orbits diverging toward clypeus; clypeus mostly rather coarsely but closely punctate, subapical part finely and closely punctate, apical margin medially shining and impunctate and with a rather distinct, slightly crenulate emargination about half as wide as basal width of clypeus and demarked by distinct angles; labrum with apex slightly emarginate; cheeks a little over half as wide as eyes, seen from side; distance between posterior ocelli considerably greater than distance to eye margin or to posterior edge of vertex. Scutum sometimes distinctly more finely and sparsely punctate than vertex; inner margin of inner hind tibial spurs with about eight small teeth, outer margin with five long ones; inner margin of outer spurs with three small teeth, outer margin with four very small, oblique teeth. Lateral teeth of sixth tergite rather large, sometimes partly testaceous; median teeth small, testaceous, about as long as broad although somewhat variable, concavity between them a little deeper than a semicircle.

This species is found in the deserts of southern California and Lower California. The male is here described for the first time.

CALIFORNIA: five miles west of Indio, April 10, 1936, on *Prosopis glandulosa* (C. D. Michener); Dos Palmos, Riverside County; Box Canyon, March 31, 1934 and April 14, 1935, on *Cercidium torreyanum* (P.H.Timberlake); Painted Canyon, April 18, 1925, on *Prosopis glandulosa* and *Cercidium torreyanum* (P.H.Timberlake); Palm Springs, April 9, 1934, on *Cercidium torreyanum* (P.H.Timberlake).

Type: female; Angel de la Guarda Island, Gulf of California, Mexico, in the collection of the California Academy of Sciences.

Ashmeadiella (Arogochila) erema sp. nov.

This is a black species with the abdomen largely red. It is most closely related to *eurynorhyncha* and *stenognatha*, from which it is easily distinguished by the broad space between the median and the lateral lobes of the clypeus.

Female: Inner margins of eyes converging slightly toward clypeus, diverging at lower ends; facial line slightly shorter than transfacial; flagellum dusky beneath; clypeus shiny, punctures separated by less than their diameters; median lobe of clypeus about as long as broad, a little narrower sub-basally

than subapically, apex shallowly emarginate medially, apical lateral corners somewhat asymeterically notched; median lobe of clypeus with a high longitudinal median carina; median lobe, seen in profile, with dorsal side at angle of about 120° to adjacent disc; lateral lobes of clypeus slender, narrowly rounded at apices, separated from median lobe by about twice their widths; apex of labrum somewhat narrowed bidentate; hypostomal carinae each produced to a tooth behind; cheeks slightly narrower than eyes, seen from side; frons and vertex closely punctured; anterior ocellus posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli slightly less than distance to nearest eye margin. Scutum without spots of hair anteriorly, a little less closely punctate than vertex; scutellum, except anteriorly, a little less closely punctate than scutum; mesepisterna punctured similarly to most of scutellum; wings nearly clear; legs black; inner margin of inner hind tibial spurs serrate with about eleven small teeth, outer margin with nine larger, slender teeth, sixth, seventh and eighth largest; outer hind tibial spurs with about five teeth on each margin, those of inner margin largest. Punctures of abdomen strong and separated by less than their diameters on basal tergites dorsally, becoming finer and closer on posterior tergites; tergites one to five with apical bands of white pubescence; tergites rather dark red, the first, fifth, and sixth black medially, second, third, and fourth with small black areas medially; sternites red laterally. Length 6 mm.

Holotype (Calif. Acad. Sci., Ent. No. 4737) and two paratypes: west side of Westgard Pass, Inyo County, California, June 15, 1937, on *Parosela fremontii* (C. D. Michener). An additional specimen is from Mazourka Canyon, Inyo Mountains, Inyo County, California, May 25, 1937, on *Parosela fremontii* (C. D. Michener).

Ashmeadiella (Arogochila) timberlakei timberlakei Michener

Ashmeadiella timberlakei Michener, 1936, Pan-Pac. Ent., **12**: 56, ♀ ♂; Michener, 1936, Am. Mus. Nov. **875**:12, 14. (Key).

This is a black species, with the abdomen largerly red. It is closely related to *lutzi* but has a shorter median lobe of the clypeus in the female.

Female: Inner margins of eyes about parallel; under side of flagellum brownish; facial line a little longer than transfacial; clypeus rather coarsely punctate, punctures rather close or separated medially by some shiny surface; margin of clypeus trilobed, lateral lobes separated from median by broad V-shaped notches; lateral lobes rounded at apices, not greatly shorter than median lobe; median lobe itself bilobed at apex; apex of labrum strongly bidentate; mandibles with apices reddish; hypostomal carinae each produced to a tooth behind; cheeks nearly as broad as eyes, seen in lateral view; anterior ocellus much posterior to midpoint between antennal sockets and posterior edge of vertex; distance between posterior ocelli equal to distance to nearest eye margin and to posterior edge of vertex; frons and vertex rather closely punctate. Scutum punctured similarly to vertex, without spots of pubescence anteriorly; tegulae testaceous, wings slightly dusky; hind femora and inner

sides of hind tibiae red; inner margin of inner hind tibial spurs serrate with about eighteen small teeth, outer margin with seven or eight long teeth; inner margin outer spurs with about seven oblique teeth, median ones largest, and sometimes one or two additional basal teeth, outer margin serrate with about nine small teeth. Abdomen strongly punctate, dorsum of second tergite with punctures separated by about their diameters (usually); punctures laterally and on posterior tergites close; sides of abdomen, back to sixth tergite, red, this color much more extensive on anterior tergites than on posterior ones, and much reduced on sixth tergite; tergites one to five with apical bands of white pubescence. Length 5½ to 6½ mm.

Male: Inner margins of eyes converging toward clypeus, except for lower portions which diverge; transfacial line a little longer than facial; clypeus not covered by white pubescence; anterior margin of clypeus truncate, truncation concave and nearly as long as basal width of clypeus; apex of labrum slightly bilobed; anterior ocellus much posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli slightly less than or about equal to distance to nearest eye margin. Inner margin of inner hind tibial spurs serrate with about a dozen or more small teeth, outer margin with seven or eight larger teeth; outer spurs with about six, low, inconspicuous teeth on each margin. Median teeth of sixth tergite short and slender. Coloration similar to that of female, teeth of sixth tergite red. Punctation similar to that of female, punctures of clypeus finer and close. Length 5 to 6 mm.

This species is found in much of the Pacific coast region, in the mountains and in the valleys west of the mountains. In the arid regions east of the Sierra Nevada it is replaced by another subspecies, described below. I have seen only a single specimen of *timberlakei* from Washington, and records for Oregon are few, but in northern and western California it is the most common species of the subgenus.

OREGON: Wild Horse Canyon, Andrews, 4270 feet elevation, June 5, 1927 (H.A. Scullen); Eagle Ridge, Klamath County, May 15, 1924 (C.L.Fox, Calif. Acad. Sci.) CALIFORNIA: Cobb Mountain, Lake County, May 7, 1936; Antioch, April 18, 21, and May 26; Mineral King, Tulare County, August 1, 1935 (all G.E. and R.M.Bohart); Yosemite, 3880 to 4000 feet elevation, May 31, 1938; El Portal, May 23, 1938; Tulomne County, 3500 feet, June 9, 1938; Bass Lake, Madera County, June 6, 1938 (all R.M.Bohart); Hastings Natural History Reservation, near Jamesburg, Santa Lucia Mountains, Monterey County, 2000 feet elevation, June 1, 1938 (C.D.Michener); Huntington Lake, Fresno County, 7000 feet elevation, July 4, 1919 (F.E.Blaisdell); Giant Forest, Tulare County, July 22, 1923 (C.L.Fox); Tamalpias, June 20, 1936, on *Lotus glaber* (P.H.Timberlake); Lake Arrowhead, San Bernardino Mountains, July 20, 1935 (M.Cazier); Idyllwild, Riverside County, June 25, 1928 (E.C.Van Dyke); Keen Camp, Riverside County, June 6 to 12, 1917 (E.P.Van Duzee); Big Pines Camp, July 12, 1927, on *Phacelia heterophylla;* Lone Pine Canyon, 4000 feet elevation, June 6, 1922, on *Lotus scoparius;* Cajon Valley, July 4, 1933, on *Lotus scoparius;* Swartout Valley, June 3, 1928, on *Phacelia davidsonii* and *P. heterophylla;* Sheep Creek, San Gabriel Mountains, June 3, 1928, on *Lotus scoparius;* Coffee Camp, June 8, 1925, on *Lotus glaber*, June 25, 1929, on *Trifolium variegatum;* Green Valley, June 9, 1933, on *Lotus scoparius;* Riverside, March 19 to May 24, on *Lotus glaber* and *L. scoparius;* the Gavilan, June 24, 1938, on *Lotus scoparius;* Puente Hills, May 11, 1930; Andreas Canyon, near Palm Springs, April 11, 1936, on *Eriodictyon crassifolium;* Badger, June 26, 1929, on *Lotus nevadensis* (all P.H.Timberlake).

Type: Female; Altadena, California, on loan to the California Academy of Sciences.

Ashmeadiella (Arogochila) timberlakei solida subsp. nov.

This form of *timberlakei* occurs in the Mojave Desert region and thence north along the east side of the Sierra Nevada at least as far as northern Inyo County. In addition to the structural characters given below, this subspecies differs from typical *timberlakei* by its distinctly larger size, but this, like the other characters, is variable.

Male: Apex of labrum slightly emarginate (somewhat variable in the paratypes, rarely as deeply so as in *timberlakei*). Length 7 mm.

Female: Median lobe of clypeus longer than in *timberlakei*, about twice as long as broad. Length 7 mm.

Holotype male, (Calif. Acad. Sci., Ent. No. 4738), allotype female (Calif. Acad. Sci., Ent. No. 4739): Lone Pine, Inyo County, California, May 24, 1937, on *Astragalus bolanderi* (C. D. Michener). Nineteen paratypes, same locality and flower record, May 19, 24, and June 5, 1937 (C. D. Michener); three paratypes, same locality, June 6, 1937 (E. C. Van Dyke).

Additional specimens of the subspecies are from CALIFORNIA: Bishop Creek, Inyo County, 8000 feet, June 22, 1937, on *Nama rothrockii* (C.D.Michener); one and one-half miles east of Glacier Lodge, Inyo County, June 21, 1937 (E.G.Gehrhardt); Palmdale, April 11, 1936 (G.E.&R.M.Bohart); Morongo, April 19, 1937, on *Lupinus arizonicus* (P.T.Timberlake). Some specimens from the southern California mountains recorded under typical *timberlakii* approach *solida*.

Ashmeadiella (Arogochila) lutzi (Cockerell)

Chelostomopsis lutzi Cockerell, 1930, Am. Mus. Nov., **397**: 2, ♀.

This species is known only from the unique type; additional material may well show *timberlakei* to be a subspecies of it. It is interesting to note that *solida* falls between *lutzi* and typical *timberlakei* not only in structure but also in distribution.

Female: Similar to *timberlakei solida* but notches separating median from lateral lobes of clypeus deeper, so that median lobe is about as long as broad; lateral lobes correspondingly longer, so that relation of lobes to one another is not altered; cheeks broader than eyes, seen from side. Length 6½ mm.

Type: Female; Mesa Verde, Colorado, in collection of the American Museum of Natural History.

Ashmeadiella (Arogochila) lateralis Michener

Ashmeadiella lateralis Michener, 1936, Pan-Pac. Ent., **12**: 60, ♂; Michener, 1936, Am. Mus. Novit., **875**: 14. (Key).

This species is similar to typical *timberlakei*, and is possibly based on an extraordinary individual of that species.

Male: Inner margins of eyes slightly converging below, except for lower thirds which diverge; under side of flagellum brownish; clypeus rather coarsely

punctate with some smooth ground between punctures; apex of clypeus with distinct, slightly produced, slightly concave truncation, aboout two-thirds as broad as basal width of clypeus; apex of labrum slightly bilobed; mandibles with reddish subapical band; cheeks somewhat narrower than eyes, seen in lateral view; front closely and finely punctate; vertex closely but a little more coarsely punctate; anterior ocellus much posterior to midpoint between antennal bases and posterior edge of vertex, distance between posterior ocelli less than distance to rear of vertex. Scutum a little more coarsely punctate than vertex, the punctures posteriorly slightly separated; anterior margin of scutum with pair of very inconspicuous spots of pubescence; punctures of mesepisterna about size of those of vertex but more strongly separated, especially below; tegulae testaceous. Abdomen strongly punctate, but punctures much finer than those of scutum; median teeth of sixth tergite short but slender, concavity between them nearly a semicircle; sides of abdomen and hind femora and inner sides of hind tibiae dark red. Length 5½ mm.

Type: Male; Eagle Rock Hills, Los Angeles County, California, on loan deposit to California Academy of Sciences. This species is known only from the unique type.

Ashmeadiella (Arogochila) salviae sp. nov.

Ashmeadiella howardi Cockerell, 1910, Ann. Mag. Nat. Hist., (8)**5**: 22, ♂, not ♀; Cockerell, 1925, Proc. Calif. Acad. Sci., (4)**14**: 206, ♂; Michener, 1936, Am. Mus. Novit., **875**: 3, ♂, not ♀.

This is a rather large species, with the abdomen red laterally. The pubescence is rather sparse, and that of the dorsum of the head and thorax is ochraceous. The female is distinguished from *cazieri, timberlakei* and *australis* by the erect, snout-like median lobe of the clypeus. The black legs suggest *cazieri,* but the male is distinguished from that species by the coarser punctation, especially of the clypeus.

Female: Head rather large, cheeks as broad as eyes seen from side, a little more finely punctate than rest of head; inner margins of eyes diverging below; anterior margin of clypeus with small, rounded, lateral lobes, separated from median lobe by broad, shallow emarginations; snout-like median lobe keeled above, its upper margin, seen in profile, at an angle hardly greater than 90° with adjacent disc of clypeus, and seen in profile, wider apically than basally; median lobe of clypeus somewhat roughened, not closely punctured; apex of labrum deeply emarginate; mandibles with inner tooth beveled; hypostomal carinae each produced to a tooth behind; anterior ocellus somewhat posterior to midpoint between antennal bases and posterior edge of vertex; head densely punctured, front a little duller than clypeus or vertex. Scutum and scutellum punctured about as vertex; no pair of hair spots at anterior edge of scutum; mesepisterna slightly more finely and less closely punctured than scutum; tegulae dark testaceous; wings slightly dusky; legs black; inner margin of inner hind tibial spurs finely serrate with a dozen or more small teeth, outer margin with nine larger teeth, basal two of which are small; both margins of outer spurs with about five, very oblique teeth. Abdomen distinctly and rather

strongly punctured, posterior tergites dull with close punctures, anterior ones more shiny, with sparser punctures; anterior tergites with posterior margins slightly more closely punctured than discs; larger punctures of abdomen as large as those of scutum, or those of sides of tergites even larger; abdominal bands narrow, that of fifth tergite inconspicuous; sixth tergite, and to a lesser extent fifth, slightly pruinose; scopa dull white; anterior four tergites broadly red at sides, fourth with a little less red than others; fifth tergite with spot of red on each side (absent in some paratypes). Length 7 mm. (6½ in some paratypes).

Male: Inner margins of eyes slightly converging toward clypeus, except for lower thirds, which diverge; flagellum hardly reddish beneath; punctures of disc of clypeus slightly separated by shiny surface, fairly coarse; punctures of anterior margin of clypeus, except for impunctate edge, finer and close; anterior margin of clypeus slightly emarginate medially, without any distinct angles forming ends of truncation, though there are slight sublateral depressions in the margin; apex of labrum slightly emarginate; mandibles reddish subapically; anterior ocellus distinctly posterior to midpoint between antennal bases and posterior margin of vertex; cheeks a little narrower than eyes, seen from side; punctures of vertex closer than those of clypeus and about the same size. Anterior part of scutum with finer punctures than vertex; mesepisterna with considerably separated punctures, about same size as those of posterior part of scutum and of vertex; teeth of hind tibial spurs about as in female. Punctures of abdomen rather strong, though finer than those of scutum; sides of tergites one to five red, red much reduced on fourth and fifth tergites (nearly absent on these tergites in some paratypes); posterior margins of tergites reddish; pubescent fasciae on posterior margins of tergites inconspicuous.

Holotype female, (Calif. Acad. Sci., Ent. No. 4740), allotype male (Calif. Acad. Sci., Ent. No. 4741), and three paratypes: Eagle Rock, California, May 9, 1936, on *Salvia mellifera* (C. D. Michener). Additional paratypes: four, same locality and flower, April 7, 1936 (C. D. Michener); two, same locality, on *Rhamnus crocea*, April 14, 1933 (C. D. Michener); five, Altadena, California, July 3, 1936, on *Salvia mellifera* (C. D. Michener, M. E. Gartz); one San Gabriel Mountains, Los Angeles County, 3000 feet, May 28, 1910 (F. Grinnell, U. S. N. M.) I have seen specimens also from Bryson, Monterey County, California, May 18, 1920 (E. P. Van Duzee); Monte Bello, California, May 1, 1934 (D. Burke); Santa Paula, California, June 5, 1927, on *Salvia mellifera* (P. H. Timberlake); and Ontario, California, June 22, 1918 (H. A. Scullen). A specimen which appears to be this species is from Westgard Pass, Inyo County, California, June 3, 1937 (E. C. Van Dyke).

Ashmeadiella (Arogochila) australis (Cockerell)

Chelostoma australis Cockerell, 1902, Bull. So. Calif. Acad. Sci., **1**: 139, ♀
Chelostoma australe Cockerell, 1903, Psyche,, **10**:76 (list).
Chelostomopsis australis Cockerell, 1935, Pan-Pac. Ent., **11**: 48 (Key).
Ashmeadiella australis Michener, 1936, Am. Mus. Nov., **875**: 11 (Key).

Chelostomopsis australis nana Cockerell, 1925, Proc. Calif. Acad. Sci., (4)**14**: 206, ♀.

This is a large black species, with the sides of the abdomen red basally. The male is easily distinguished from other species of *Arogochila* by the elongated median teeth of the sixth tergite, and the female by the irregular, tapering median lobe of the clypeus.

Female: Inner margins of eyes diverging toward clypeus; under side of flagellum dusky; clypeus with large, elongated punctures; clypeus with lateral lobes mere angles, not separated from median lobe by emarginations, median lobe broad, with irregular margin, and with longitudinal dorsal carina, and seen in profile with upper side at angle of over 150° to lower part of disc of clypeus, not projecting sharply as in *salviae;* apex of labrum bidentate; inner tooth of mandibles weak, only an obtuse angle; hypostomal carinae each produced to an angle posteriorly; cheeks broader than eyes, seen from side; anterior ocellus distinctly posterior to midpoint between antennal sockets and posterior edge of vertex; vertex closely punctate, more finely so than clypeus. Scutum with punctures similar to those of vertex, but sometimes slightly more distinctly separated, like those of mesepisterna; no pair of hair tufts at anterior end of scutum; tegulae testaceous exteriorly; hind femora red; inner sides of hind tibiae red; inner margin of inner hind tibial spurs serrate with well over a dozen rather fine teeth, outer margin with six large teeth and a small one basad to them; inner margin of outer spurs with five rather large teeth, outer margin with six or seven smaller, oblique teeth. Abdomen strongly punctured, punctures finer than those of scutum; sides of first two tergites red; posterior margins of tergites reddish; abdominal bands weak, that of fifth tergite nearly absent. Length about 8 mm.

Male: Coloration similar to that of female, but red reduced, the second tergite and sometimes the first with but little red; inner margins of eyes parallel, lower parts diverging; clypeus not covered with white pubescence, rather finely punctate, its anterior margin with a very weakly defined truncation, nearly as long as basal width of clypeus; apex of labrum weakly emarginate; cheeks nearly as broad as eyes seen from side; anterior ocellus posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli somewhat less than distance to posterior edge of vertex and about equal to distance to eye margin; inner margin of inner hind tibial spurs with about ten rather fine teeth, outer margin with five large teeth; both margins of outer spurs with about five teeth, distal ones largest.

Anterior part of scutum more finely punctate than disc of scutum or vertex, disc of scutum a little more finely punctate than vertex; mesepisterna punctured much as vertex. Abdomen strongly punctured, punctures larger than those of scutum; median teeth of sixth tergite long and slender, rather broadened basally, emargination between them much deeper than a semicircle. Length 6½ to 7 mm.

This species is found in the mountains of central and southern California. It is apparently oligotropic on species of *Pentstemon*.

CALIFORNIA: Yosemite Valley, June 19, 1921 (E.C.VanDyke, Calif. Acad. Sci.);

Tenaya Lake Trail, Yosemite National Park, 7000 feet elevation, July 21, 1936 (G.E. and R.M.Bohart); Oak Creek Canyon, near Independence, Inyo County, California, on *Pentstemon breviflorus* (C.D.Michener); Bear Valley, San Bernardino Mountains, August 9, 1933, on *Pentstemon grinnelli* (P.H.Timberlake); Mill Creek, San Bernardino Mountains, 6000 feet elevation, June 21 and 30, 1936, on *Pentstemon grinnelli* (P. H.Timberlake); San Antonio Canyon, north of Ontario, 6500 feet elevation, June 20, 1931 (H.A.Scullen).

Type: Female; (near) Los Angeles, California.

The form named *nana* occurs with the typical form, intergrading with it, and is apparently not worthy of a name. The male of this species is here described for the first time.

Ashmeadiella (Arogochila) cazieri sp. nov.

This is a species in which the abdomen is largely red. The female differs from that of *timberlakei* by the more produced, narrowly truncated median lobe of the clypeus and the narrowly truncate labrum. This species is also related to *salviae*, but differs by the smaller median lobe of the clypeus, truncated labrum, etc. The male is distinguished from that of *salviae* by the more finely punctate clypeus.

Female: Inner margins of eyes slightly divergent toward clypeus; facial line a little longer than transfacial; under side of flagellum brown; punctures of clypeus fairly large, elongated longitudinally, and separated by conspicuous shiny ground; anterior margin of clypeus with lateral lobes small and slightly angled at apices, median lobe large and elongate, at base a little broader than basal width of clypeus, at apex narrowly truncate; apex of median lobe of clypeus triangular in cross-section; median lobe with longitudinal dorsal carina, and seen in lateral view with upper side at angle of about 135° to adjacent disc of clypeus; apex of labrum narrowly truncate, truncation a little concave; cheeks a little narrower than width of eyes, seen from side; anterior ocellus far posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli greater than distance to nearest eye margin and equal to distance to posterior edge of vertex; punctures of vertex a little finer and closer than those of scutum. Scutum without spots of pubescence anteriorly, punctures nearly approximate; punctures of mesepisterna about same size as those of scutum; wings clear; tegulae testaceous; inner margin of inner hind tibial spurs finely serrate with about eleven small teeth, outer margin with about seven large teeth; outer spurs with four or five moderate sized oblique teeth on each margin. Punctures of abdomen strong, those of abdomen seperated by about their diameters; punctures of posterior margins of tergites, especially second tergite, distinctly finer than those of rest of tergites; tergites red, dorsal median areas black, amount of black small on first tergite and increasing posteriorly, sixth tergite with only a little red at sides; sternites, especially basal ones, partly red; tergites one to five with apical bands of white pubescence; sixth tergite, and to a lesser extent fifth, pruinose; scopa nearly white. Length 6 mm. (5 mm. in a paratype).

Male: Coloration similar to that of female; inner margins of eyes converg-

ing below, except for lower portions where they diverge; transfacial line longer than facial line; apex of clypeus slightly elevated, smooth, with slight concavity nearly as long as basal width of clypeus; punctures of clypeus fine, close; apex of labrum rounded; punctures of labrum rather coarse, separated by but little shiny ground; cheeks hardly half as wide as eyes, seen from side; frons and vertex rather coarsely and closely punctate; anterior ocellus considerably posterior to midpoint between antennal bases and posterior end of vertex; distance between posterior ocelli greater than distance to eye margin or to posterior edge of vertex. Scutum with punctures of same size as those of vertex, separated on disc by a little shiny ground; cheeks and mesepisterna a little more finely punctate than scutum; inner margin of inner hind tibial spurs with about eight small teeth, outer margin with five large teeth and a smaller one basad to them. Punctures of first four abdominal tergites dorsally nearly as coarse as those of scutum and separated by considerably less than their diameters; punctures of fifth and sixth tergites finer and closer; abdomen with more red than in female, posterior margins of tergites broadly red, and teeth at apex of abdomen red; sternites except first, red; median teeth of sixth tergite small, narrow, slightly longer than broad, concavity between them slightly broader than a semicircle. Length 4 mm.

Holotype female (Calif. Acad. Sci., Ent. No. 4742) and one paratype: Dos Palmos, Riverside County (Colorado Desert), California, March 19, 1934 (from collection of Mont A. Cazier, after whom the species is named). Allotype male (Calif. Acad. Sci., Ent. No. 4763) and two paratypes from same locality, March 28, 1934 (from collection of G. E. and R. M. Bohart). One female paratype, Box Canyon, California, March 31, 1929, on *Cercidium torreyanum*, and one from Painted Canyon, California, April 18, 1925, on same flower (P. H. Timberlake). Paratypes will be found in the collections of Messrs. Bohart, Timberlake, and Cazier, and in that of the author. Two additional males from Dos Palmos represent a species distinct from the male described above, and possibly the true male of *cazieri*. I have associated the sexes largely on the basis of the entirely black femora in both male and female (as understood by me) of *cazieri*, the other form having the hind femora largely red.

Additional specimens of this species are from Mazourka Canyon, Inyo Mountains, Inyo County, California, May 25, 1937, on *Parosela fremontii* (C.D.Michener) and west side of Wastgard Pass, Inyo County, California, May 27, 1937, on *Parosela fremontii* (C.D.Michener). Some females from these localities have the punctuation of the vertex and the scutum approximately the same.

Ashmeadiella (Arogochila) foxiella sp. nov.

This is a black species without red markings. The pubescence is rather sparse, that of the dorsum of head and thorax ochraceous. This species is the only known black male *Arogochila*. Although several black females are known, *foxiella* cannot be associated with any of them. *A. neomexicana* is a species of the southern desert areas, while *sculleni* is too large to be the female of the present species. In addition to the black color, the coarsely and com-

paratively sparsely punctate clypeus, without a distinct emargination anteriorly, separates this species from its relatives.

Male: Inner margins of eyes about parallel, lower thirds strongly diverging; under side of flagellum dusky; clypeus not covered by hair; clypeus convex, shiny, with coarse punctures separated by about half their diameters; anterior margin of clypeus with a hardly concave truncation, the ends of which are rounded; truncation shorter than basal width of clypeus; apex of labrum faintly bilobed; mandibles slightly reddish; cheeks as wide as eyes, seen from side; frons and supraclypeal area very closely punctate, more finely so than clypeus; vertex with punctures of same size as frons, but a little more distinctly separated; anterior ocellus posterior to midpoint between bases of antennae and posterior end of vertex. Scutum without pair of pubescent spots anteriorly, punctures of disc a very little finer and more distinctly separated than those of vertex, usually separated by about one-third their diameters; punctures of anterior part of scutum considerably finer than those of disc; punctures of mesepisterna much like those of disc of scutum; wings slightly dusky; tegulae dark piceous; outer margin of inner hind tibial spurs with seven rather large oblique teeth; outer spurs with four or five oblique teeth on each side. Punctures of abdomen fairly strong, only a little finer than those of scutum, those of dorsum of second tergite separated by about their diameters except at base of tergite where they are finer and close; posterior margins of abdominal segments brownish; tergites one to five with apical bands of pale pubescence; median teeth of sixth tergite somewhat longer than basal width, broadened basally, apical parts slender, concavity between them longer than a semicircle. Length 6½ mm.

Holotype (Calif. Acad. Sci., Ent. No. 4743): Eagle Ridge, Klamath Lake, Oregon, May 31, 1924 (C. L. Fox). A paratype (length 5 mm.), topotypical, June 3, 1924. Three specimens from Truckee, California, June 20, 1927 (E. P. Van Duzee) belong to the same species. In these the apex of the labrum is not emarginate, and in one of them the inner orbits converge slightly toward the clypeus except for their lower thirds.

Subgenus **Corythochila** subg. nov.

This subgenus is established for two species found in the deserts of Arizona, Nevada, and southern California. It is distinguished from other subgenera by the combination of mandibular characters of the two sexes, the female having quadridentate mandibles, the male bidentate. The female is easily distinguished from *Chilosima*, which also has quadridentate mandibles, by the short clypeus, the anterior margin of which is furnished with median and lateral projections. Males, so far as I can observe, are not distinguishable from *Arogochila*, so that they have been included in the key to the species of that subgenus. *Corythochila* is indeed very closely allied to *Arogochila*, but the shorter clypeus and its characteristic apical projections, and the narrowed gular groove of the female seem to justify its separation, although one speceis of *Arogochila* has quadridentate female mandibles.

Female: Face broad; mandibles more than twice as long as scape, quadridentate at apex; mandibles with distance from first to fourth tooth slightly less than half total length; labrum bidentate at apex; clypeus short, without orange brushes beneath margin, apical margin hardly produced beyond line joining lower ends of eyes, and produced slightly over labrum; gular groove somewhat narrowed behind; hypostomal carinae each produced to a posterior projection; hind tibial spurs with few teeth.

Male: Mandibles bidentate, inner margin basad to inner tooth hardly swollen; labrum slightly bilobed at apex; gular groove not narrowed posteriorly, but hypostomal carinae elevated posteriorly; hind tibial spurs with few teeth; lateral margins of sixth tergite convex, lateral teeth broad.

Type: *Ashmeadiella (Corythochila) inyoensis* Michener, described below.

KEY TO THE SPECIES OF CORYTHOCHILA

FEMALES

Apex of clypeus with small, rounded, median projection ..... *inyoensis*
Apex of clypeus with small, emarginate, median projection, often so reduced as to be hardly distinguishable ..... *breviceps*

MALES

Lower parts of cheeks and areas between eyes and lateral ocelli with punctures approximate or nearly so; hind tibial spurs strongly toothed ..... *inyoensis*
Lower parts of cheeks and areas between eyes and lateral ocelli with punctures often rather widely separated; hind tibial spurs nearly edentate..... *breviceps*

Ashmeadiella (Corythochila) inyoensis sp. nov.

This is a small species with a short clypeus. It is black with the abdomen largely red, and is distinguished from *breviceps* in both sexes by the strong teeth of the tibial spurs, in the female by the entire median lobe of the clypeus and the more coarsely punctate scutum, and in the male by the coarser and closer punctures of the entire body.

Female: Inner margins of eyes diverging toward clypeus; cheeks and face except clypeus densely white hairy; under side of flagellum dusky (reddish in many paratypes); clypeus with large punctures, separated by some smooth surface; apical margin of clypeus angularly produced laterally, produced to a lobe medially; labrum bidentate at apex, the teeth rather slender, surface smooth between punctures; mandibles reddish medially, outer tooth longer than others; first segment of labial palpus a little longer than second; cheeks nearly as broad as eyes seen from side; anterior ocellus posterior to midpoint between antennal sockets and posterior edge of vertex; distance between posterior ocelli slightly greater than distance to posterior edge of vertex; punctures of vertex and scutum rather small, those of vertex approximate; scutum margined with white pubescence all around; punctures of scutum slightly larger than those of vertex, many of them separated by half their diameters; tegulae testaceous; wings clear; scutellum pubescent posteriorly, its punctures smaller and closer than those of scutum; mesepisterna densely white pubescent, punctured similarly to scutellum; under side of hind tibiae reddish; inner mar-

gin of inner hind tibial spurs nearly entire, outer margin with five large teeth and two smaller ones basad to them; outer spurs with about five distinct but oblique teeth on each margin. Abdominal tergites with punctures nearly as large as those of scutellum; tergites one ot five with distinct apical bands of white pubescence; first tergite red; second to sixth with middorsal black patches increasing in size on posterior segments so that sixth tergite is red laterally only; sternites reddish laterally, basal ones largely reddish; scopa white. Length 5½ mm.

Male: Inner margins of eyes converging below, except for their lower parts, which diverge; cheeks and face covered with white pubescence; flagellum brown beneath; apical margin of clypeus with shallow emargination, nearly three-fourths as wide as basal width of clypeus; mandibles red except basally and apically; labrum subtruncate at apex, strongly punctured; cheeks about half as broad as eyes, seen from side, closely punctate; anterior ocellus considerably posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli considerably greater than distance to nearest eye margin or to posterior margin of vertex; punctures of vertex rather large and nearly approximate; punctures of scutum slightly larger than those of vertex, broadly separated by nearly their diameters, or closer on midline; scutum margined all around with white pubescence; scutellum and mesepisterna more finely and closely punctate than scutum; tegulae testaceous; tarsi brown; under side of posterior tibiae reddish brown; inner margin of inner hind tibial spurs finely serrate, outer margin with about five large sharp teeth; inner margin of outer hind tibial spurs with about three oblique teeth, outer margin with about five oblique teeth. Punctures of tergites nearly as coarse as those of scutellum, approximate laterally, separated by less than their diameters dorsally; abdomen red, sternites black medially, tergites one to six with black median areas, smallest on six, becoming progressively larger anteriorly to th ethird, which has largest black area, and decreasing in size anteriorly, first tergite having only small black area (most paratypes exhibit more black, the sixth tergite being largely black); posterior margins of all tergites broadly red; sixth tergite with emargination between median teeth broader than semicircle; median teeth broader than long, rounded translucent testaceous. Length 4½ mm.

Holotype female (Calif. Acad. Sci., Ent. No. 4744), allotype male (Calif. Acad. Sci., Ent. No. 4745) and eight paratypes: Lone Pine, Inyo County, California, June 9, 1937, on *Parosela polyadenia* (C. D. Michener); seven paratypes, same locality, flower, and collector, June 15, 1937; four paratypes, same locality, June 13, 1937 (E. C. Van Dyke).

Mr. P. H. Timberlake has lent me a single female specimen which he collected five miles east of Edom, California, April 10, 1937, on *Parosela schottii*, which is larger than typical *inyoensis* and has more black on the abdomen than that species, even the first tergite being black medially. Structurally, however, it seems to agree with *inyoensis*.

Ashmeadiella (Corythochila) breviceps sp. nov.

This species has the aspect of *inyoensis*, to which it is closely related. It differs by the almost toothless hind tibial spurs of both sexes, by the bilobed, often reduced, median, marginal, clypeal projection of the female, and the finer punctation of both sexes.

Female: Inner margins of eyes parallel, their lower ends diverging below; face except clypeus and cheeks densely white hairy; under side of flagellum brown; clypeus rather coarsely punctate (more finely so than in *inyoensis*); apical margin of clypeus produced to a strong angle at each side, and to a slight, bilobed, median projection; labrum with apex narrowly notched, teeth on either side of notch broad, surface finely granular between punctures; mandibles reddish, base and teeth black; apical tooth of mandibles longer than others; cheeks narrower than eyes, seen from side; anterior ocellus much posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli greater than distance to nearest eye margin or to posterior edge of vertex; punctures of vertex fine and approximate; punctures of scutum slightly coarser than those of vertex, separated by a little smooth surface; scutum margined all around with white pubescence; mesepisterna covered wtih white pubescence; scutellum and mesepisterna slightly more finely punctate than scutum; tarsi slightly rufescent; hind femora red; hind tibiae red except outer sides; hind tibial spurs with about three low, inconspicuous teeth on each margin; wings clear. Abdomen red, considerably more finely punctate than scutellum; scopa white; tergites one to six with apical bands of white pubescence, fifth and sixth tergites pruinose. Length 4½ mm. (varying to 5½ in some paratypes).

Male: Inner margins of eyes converging below except for lower parts which diverge; face covered with white pubescence; apex of clypeus with short concave space about two-thirds as long as base of clypeus; labrum rounded at apex; mandibles reddish, black basally and apically; flagellum reddish beneath; distance from anterior ocellus to bases of antennae nearly twice distance from anterior ocellus to posterior edge of vertex; distance between posterior ocelli greater than distance to eye or to posterior edge of vertex; vertex rather coarsely punctured, punctures separated by somewhat less than half their widths; cheeks about or slightly less than half width of eyes, seen from side. Scutum with punctures slightly smaller than those of vertex (coarser in another male specimen), separated by nearly half their diameters; mesepisterna more finely punctured than vertex; small segments of tarsi (or entire tarsi) somewhat rufescent; hind tibial spurs nearly entire. Punctures of first tergite fine and separated on dorsum by about one puncture width; punctures of following tergites coarser, separated by less than one puncture width; punctures of sides of tergites and of posterior tergites closer, not approximate and not as coarse as those of scutum; pubescent fasciae of tergites weak; first tergite red, second and third red except for transverse sub-basal black areas, that of third larger than that of second; fourth and fifth tergites with red on extreme sides and with broad apical margins red; teeth of sixth tergite largely

red, lateral ones acutely pointed; margin of sixth tergite between lateral and median teeth fairly long and straight; median teeth broader than basal width, sides converging to rounded apex; concavity between median teeth broader than a semicircle. Length nearly 4 mm.

Holotype female (Calif. Acad. Sci., Ent. No. 4746) and three female paratypes: Cathedral City, Riverside County, California, on *Larrea tridentata* var. *glutinosa,* April 10, 1936 (C. D. Michener). One female paratype from two miles west of Edom, Riverside County, California, on same flower, March 26, 1936 (E. G. Linsley). Allotype male (Calif. Acad. Sci., Ent. No. 4747) and two female paratypes from Dos Palmos, Colorado Desert, California, March 19, 1934 (Cazier colelction) Two female and two male paratypes, La Quinta, California, March 4, 1936, and March 17 and May 2, 1934, on *Hyptis emoryi* and *Larrea glutinosa* (P. H. Timberlake); one female paratype, five miles east of Edom, California, April 10, 1937, on *Larrea glutinosa* (P. H. Timberlake). Additional specimens are from Arizona (no locality, Acad. Nat. Sci. Phila.) and Las Vegas, Nevada, April 15, 1930, on *Dipetalia linifolia* (D. E. Fox, U. S. N. M.).

Males vary considerably in the amount of black on the abdomen, some having an infuscated area on the first tergite, some having the first three tergites almost entirely red.

Subgenus **Chilosima** subg. nov.

This distinct subgenus contains three, rather robust species. The males are easily distinguished from all other *Ashmeadiella* by the tridentate mandibles. The females resemble *Corythochila* in the quadridentate mandibles, but are not closely related to that subgenus, the clypeus being more produced and without lateral projections.

Female: Face broad; mandibles rather slender, quadridentate apically (very rarely tridentate because of reduction of third tooth), distance from first to fourth tooth less than half length of mandible; clypeus without orange brushes beneath margin, produced well over base of labrum and beyond a line drawn between lower ends of eyes; gular groove not greatly narrowed posteriorly; hind tibial spurs with rather few teeth.

Male: Mandibles tridentate; gular groove not greatly narrowed posteriorly; hind tibial spurs with few teeth; lateral margins of sixth tergite slightly convex, lateral teeth of sixth tergite rather broad.

Type: *Ashmeadiella rhodognatha* Cockerell.

Key to the Species of Chilosima

FEMALES

Apex of clypeus with a median, abruptly produced truncation; facial line fully as long as transfacial ..... *washingtonensis*

Apex of clypeus broadly rounded,, somewhat crenulate; facial line much shorter than transfacial ..... *rhodognatha*

MALES

Abdomen black ..... *rhodogmatha*

Abdomen red ..... *holtii*

Ashmeadiella (Chilosima) rhodognatha Cockerell

Ashmeadiella rhodognatha Cockerell, 1925, Proc. Calif. Acad. Sci., (4) **12**: 557, ♀; Cockerell, 1935, Pan-Pac. Ent., **11**. 48.

This is a short, robust, black species with much white pubescence.

Female: Head much broader than long; face, especially laterally, covered with white pubescence; inner margins of eyes nearly parallel; clypeus rather finely and closely punctate, its margin broadly rounded, slightly turned outward, and rather broadly crenulated; apex of labrum subtruncate; mandibles usually largely red, quadridentate (rarely tridentate because of reduction of third tooth), apical tooth long, next tooth longer than inner two, which are small and often inconspicuous; cheeks narrower than eyes, seen from side; anterior ocellus posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli about equal to distance to nearest eye margin and to posterior edge of vertex; occipital carina complete and evident from above; vertex a little more coarsely punctate than clypeus, punctures approximate; flagellum reddish beneath. Scutum more sparsely punctate than vertex, margined with white pubescence, band broadest on anterior side; tegulae reddish testaceous; hind tibial spurs with inner margin with few, inconspicuous, small teeth, outer margin with five large teeth; outer spurs with four rather large, slender teeth on inner margin and three lower, oblique teeth on outer margin. Abdomen with punctures quite fine and rather sparse on discs of basal tergites, but as coarse as those of clypeus on sides; posterior margins of tergites reddish with broad bands of white pubescence; scopa white. Length 5 to 6½ mm.

Male: Coloration and pubescence except on face similar to that of female; face much broader than long, densely covered with white pubescence; inner margins of eyes converging toward clypeus except for lower parts which diverge; clypeus short, margin crenulate, a sublateral emargination on each side deeper than any of the others; apex of labrum broadly rounded; mandibles with apical tooth very long; cheeks considerably narrower than eyes, seen from side; inner margin of inner hind tibial spurs nearly entire, outer with five somewhat oblique teeth; outer spurs with three teeth on each margin; lateral teeth of sixth tergite variable, sometimes short and broadly rounded, at other times longer and narrowly rounded apically; median teeth longer than basal width, concavity between them longer than a semicircle. Length 5 to nearly 6 mm.

This species occurs in the deserts of California and Lower California.

CALIFORNIA: Cathedral City, Riverside County, April 10, 1936, on *Parosela schottii* and *Cercidium torreyanum* (C.D.Michener); Lone Pine, Inyo County, June 15, 1937, on *Parosela polyadenia* (C.D.Michener, E.C.VanDyke); Furnice Creek, Death Valley, Inyo County, April 14, 1938, on *Pluchea sericea* (B.E.White); four miles east of Edom, September 17, 1937, on *Dalea schottii;* Box Canyon, March 31 and April 13, 1934, on *Cercidium torreyanum;* Painted Canyon, April 18, 1925, same flower; near Oasis, April 19, 1925, same flower; five and one-half miles north west of Indio, April 9, 1936, on *Prosopis glandulosa* (all P.H.Timberlake).

Type: Female; San Jose Island, Gulf of California, in California Academy of Sciences.

Ashmeadiella (Chilosima) holtii Cockerell

Ashmeadiella holtii Cockerell, 1898, Can. Ent., **30**: 51, ♂; Cockerell, 1898, Bull. Denison Univ., **11**: 64 (key); Cockerell, 1898, Bull. Univ. New Mex., **1**: 64 (key). *Eriades holti* Friese, 1911, Das Tierreich, **28**: 28, ♂.

This species, known only in the male, is similar to *rhodognatha,* differing chiefly in the entirely red abdomen and the largely red legs. The structure and punctation of the two species are about the same.

Male: Face broader than long, densely covered with white pubescence; inner margins of eyes converging below, less curved than in *rhodognatha;* mandibles reddish except basally and apically, apical tooth long; cheeks much narrower than eyes, seen from side; tegulae testaceous; legs red, fore and middle femora and coxae suffused with black; abdomen yellowish red; lateral teeth of sixth tergite rather broad; median teeth of sixth tergite longer than basal width, concavity between them longer than a semicircle.

This species occurs in Arizona and New Mexico. The Arizona record is based on a specimen in the National Museum, without exact locality data.

Type: Male; Mesilla Valley, New Mexico, in the United States National Museum.

Ashmeadiella (Chilosima) washingtonensis sp. nov.

This is a black species, sparsely pubescent, and more slender than *rhodognatha,* from which it differs by the produced, truncate clypeus. The second mandibular tooth is not larger than the third and fourth, whereas in *rhodognatha* the second tooth is considerably larger than the third and fourth. In the absence of the male, the placement of the species in *Chilosima* is perhaps subject to some doubt.

Female: Transfacial line about as long as facial line; inner margins of eyes nearly parallel, their lower parts diverging slightly toward mandibles; anterior margin of clypeus with a median, abruptly produced truncation, with a slight median notch; laterad to truncation margin of clypeus transverse for a distance before receeding; clypeus, except for produced margin, rather coarsely punctate, punctures separated by about half their diameters; mandibles dark red, apical tooth long, others subequal; labrum broad medially, bilobed at apex; first segment of labial palpus a little longer than second; under side of flagellum brownish; supraclypeal area and sides of face nearly as coarsely punctate as but more closely punctate than clypeus; distance from anterior ocellus to posterior edge of vertex about half distance to antennal sockets; distance between posterior ocelli a little greater than distance to nearest eye margin or to posterior edge of vertex; vertex finely and closely punctate; frons closely but slightly more coarsely punctate, though distinctly more finely punctate than supraclypeal area; occipital carina absent; cheeks hardly narrower than eyes, seen from side, a little more finely punctate than supraclypeal area, punctures separated, especially below, by considerable shiny surface. Scutum more coarsely punctate than vertex, rather closely so, without pair of pubescent spots anteriorly; wings dusky; tegulae dark brown; mesepisterna more coarsely punctate than scutum, punctures separated by shiny ground; legs slightly suffused

with brown; inner margin of inner hind tibial spurs serrate with eleven oblique teeth, outer margin with six, somewhat oblique teeth, distal four large; inner margin of outer hind tibial spurs with eight small oblique teeth, basal four of which are considerably smaller than distal four. Abdomen coarsely punctate, punctures of second tergite as coarse as those of scutum, separated by less than half their diameters; first tergite and posterior margins of tergites little more finely punctate; punctures of tergites four to six close; posterior margins of tergites slightly brownish; tergites one to five with apical hair bands of white pubescence; scopa whitish.

Holotype: North Yakima, Washington, May 23, 1903 (Eldred Jenne), received through Mr. Roy D. Shenefelt of Washington State College, at whose request it has been sent to the United States National Museum.

Subgenus **Cubitognatha** subg. nov.

This subgenus is established for a single species, the characters of which are very extraordinary. The bidentate, elbowed mandibles distinguish it from all female Osmiinae known to be. There seems to be no immediate relationship between this and the other subgenera of *Ashmeadiella,* and it is possible that the discovery of the male will show that it is a distinct genus.

Female: Mandibles slender, bent before middle, strongly bidentate at apices; clypeus short, without orange brushes, its apical margin straight, on a plane with base of labrum, not reaching anterior to line between lower ends of eyes; upper margin of clypeus elevated; surface of clypeus largely impuntate; gular groove greatly narrowed posteriorly by the broadly expanded and inward projecting hypostomal carinae.

Type: *Ashmeadiella (Cubitognatha) xenomastax* Michener, described below.

Ashmeadiella (Cubitognatha) xenomastax sp. nov.

This extraordinary species is the sole representative of its subgenus. It is rather robust, with large head, black, the abdomen largely red.

Female: Inner margins of eyes diverging below; under side of flagellum reddish brown; base of clypeus strongly elevated to a sharp, transverse ridge; clypeus anterior to this ridge slightly swollen medially, smooth except for some fine roughening above, and with a few long hairs directed foreward and curved slightly downward; labrum long, bidentate at apex, base impunctate; mandibles with outer tooth longer than inner, transverse reddish band just basad to teeth; upper side of mandibles with a row of tufts of long, slightly curved hairs, directed inward; lower side of mandibles similarly furnished with hairs; lower ends of cheeks with long hairs curved anteriorly; cheeks as broad as eyes, seen from sides; gular groove greatly narrowed posteriorly by the expanded hypostomal carinae, each of which is produced nearly to a tooth posteriorly; anterior ocellus about midway between antennal bases and posterior edge of vertex; distance between posterior ocelli distinctly less than distance to posterior edge of vertex; punctures of frons and vertex slightly separated from one another. Scutum punctured about as vertex, anterior margin

with indistinct pair of spots of hair; tegulae dark testaceous; mesepisterna somewhat more finely punctured than scutum; wings clear; hind femora and hind tibiae except outer side red; hind tibial spurs black, inner margin of inner spurs finely serrate, outer margin with about eight long teeth, most of which are longer than broad; outer hind tibial spurs with about six long, oblique teeth on each margin, those of outer margin smaller. Abdomen slightly more finely punctate than scutum; first tergite red, second to sixth red with median dorsal black areas, that of second indistinct and small, their size increasing posteriorly so that that of sixth tergite occupies about one-third of the tergite; first sternite largely red, others black, red laterally; tergites one to six with distinct, narrow, apical bands of pubescence; scopa white. Length 7 mm. (varying to just over 5 mm. in one paratype).

Holotype (Calif. Acad. Sci., Ent. No. 4748) and eight paratypes: Big Pine, Inyo County, California, June 8, 1937, on *Parosela polyadenia* (E. C. VanDyke, C. D. Michener). One paratype, Lone Pine, Inyo County, California, June 15, 1937, on *Parosela polyadenia* (C. D. Michener). Other specimens are from Lovelock, Nevada, June 9, 1933 (J. T. Howell); Olancha, Inyo County, California, May 26, 1937 (J. W. Johnson); about eight miles south of Victorville, California, May 22, 1932, on *Lupinus odoratus* (P. H. Timberlake); five miles east of Edom, California, April 10, 1937, on *Parosela schottii* (P. H. Timberlake).

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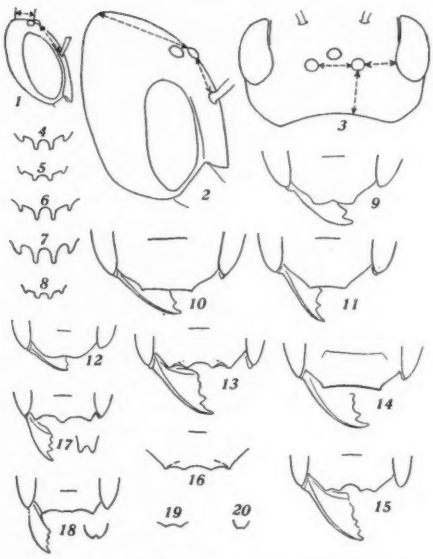
Plate 1

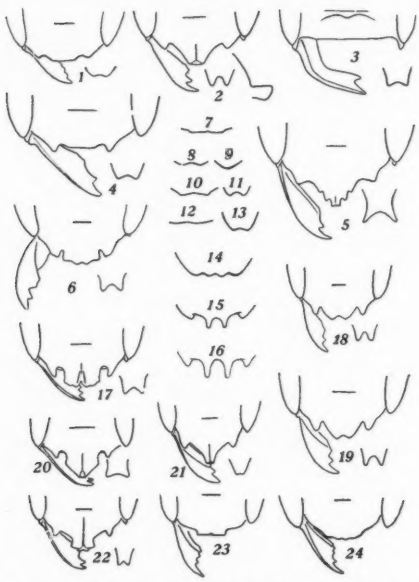


1. Lateral view of head of *Ashmeadiella sonora* Michener, female.
2. Same, *A. bucconis bucconis* (Say), large female.
3. Dorsal view of head of *A. maxima* Michener, female.

Arrows in the above figures indicate the way in which certain measurements mentioned in the keys and descriptions are to be taken.

4. Posterior margin of sixth tergite of *A. femorata* (Michener), male.
5. Same, *A. bigeloviae* (Cockerell), male.
6. Same, *A. haematopoda* Cockerell, male.
7. Same, *A. californica* (Ashmead), male.
8. Same, *A. prosopidis* (Cockerell), male.
9. Lower part of face, with one mandible, of *A. dimalla* Michener, female.
10. Same, *A. opuntiae* (Cockerell), female.
11. Same, *A. californica* (Ashmead), female.
12. Same, *A. curriei* Titus, female.
13. Same, *A. cubiceps cubiceps* (Cresson), female.
14. Same, *A. biscopula* Michener, female.
15. Same, *A. pronitens* (Cockerell), female.
16. Margin of clypeus of *A. cubiceps clypeata* (Michener), female topotype.
17. Lower part of face, with one mandible and apex of labrum, of *A. inyoensis* Michener, female.
18. Same, *A. breviceps* Michener, female.
19. Middle of apical margin of clypeus of *A. inyoensis* Michener, male.
20. Apex of labrum of *A. inyoensis* Michener, male.

Plate 2



1. Lower part of face, with one mandible and apex of labrum, of *A. barberi* Michener, female.
2. Same, with profile of clypeus added, of *A. salviae* Michener, female.
3. Lower part of face, with one mandible and apex of labrum, of *A. xenomastax* Michener, female.
4. Same, *A. sculleni* Michener, female.
5. Same, *A. australis* (Cockerell), female.
6. Same, *A. clypeodentata* Michener, female.
7. Middle of apical margin of clypeus of *A. salviae* Michener, male.
8. Same, *A. cazieri* Michener, male.
9. Apex of labrum of *A. cazieri* Michener, male.
10. Middle of apical margin of clypeus of *A. timberlakei* Michener, male.
11. Apex of labrum of *A. timberlakei* Michener, male.
12. Middle of apical margin of clypeus of *A. foxiella* Michener, male.
13. Apex of labrum of *A. foxiella* Michener, male.
14. Posterior margin of sixth tergite of *A. eurynorhyncha* Michener, male.
15. Same, *A. salviae* Michener, male.
16. Same, *A. australis* (Cockerell), male.
17. Lower part of face, with one mandible and apex of labrum, of *A. stenognatha* Michener, female.
18. Same, *A. timberlakei timberlakei* Michener, female.
19. Same, *A. timberlakei solida* Michener, female. ....
20. Same, *A. eurynorhyncha* Michener, female.
21. Same, *A. cazieri* Michener, female.
22. Same, *A. erema* Michener, female.
23. Lower part of face, with one mandible, of *A. washingtonensis* Michener, female.
24. Same, *A. rhodognatha* Cockerell, female.

Faunal Relationships and Geographic Distribution of Mammals in Oklahoma

W. Frank Blair

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Introduction

The mammalian fauna of Oklahoma, until recently, has been less well known than that of perhaps any other state. The collections of mammals that have been made in the state, although relatively numerous, are for the most part individually rather small, and they are distributed in many institutions. Heretofore, no attempt has been made to bring this scattered material together and determine the pattern of mammalian distribution in the state. The only list of the mammals of the state is a list of 57 species and races—none substantiated by records—prepared by Howard Cross and published in Snider (1917: 201). Of the species and races in this list, no specimens of 10 have been recorded from the state, and 5 are obviously incorrectly included in the state list. Published records of Oklahoma specimens are limited almost entirely to the generic revisions in the North American Fauna series.

The history of mammalian research in Oklahoma falls into two fairly distinct periods. The first period extended through approximately the last decade of the nineteenth century and the first 5 years of the present century. In this period Thaddeus Surber collected mammals first in the Arbuckle Mountains, in Cleveland County, and in Woods County for the Field Museum of Natural History and later in the northeastern corner of the state for the Museum of Comparative Zoology. In the first part of the period the collectors Jenness Richardson and Charles P. Rowley made small collections of mammals in northwestern Oklahoma and the Panhandle for the American Museum of Natural History. During this period, also E. A. Preble, James H. Gaut, and other collectors for the United States Bureau of Biological Survey obtained some mammals in the state, particularly in the Ouachita and Wichita Mountains and in Woodward County. At the same time a few specimens, particularly of the larger species, were being accumulated in the University of Kansas, Museum of Birds and Mammals. For the next

20 years there was virtually no collecting of mammals in Oklahoma, except for a little by R. C. Hughes mostly in the Arbuckle Mountains, in the early 1920's. The second period of mammal collecting in Oklahoma extended over approximately the last 10 years. During this time the University of Kansas accumulated specimens from several localities in northwestern Oklahoma. The University of Oklahoma obtained specimens from the vicinity of Norman, and in the summer of 1936 H. L. Whitaker made a fairly large collection in the Ouachita Mountains and in the southeastern corner of the state. The Oklahoma Agricultural and Mechanical College accumulated specimens mostly from the vicinity of Stillwater, through the efforts of R. C. Hughes and George A. Moore. In the summer of 1930, H. H. T. Jackson of the United States Bureau of Biological Survey and members of the University of Oklahoma Biological Survey collected mammals in the vicinity of the salt plains of north-central Oklahoma. In 1936 and 1937, George M. Sutton, although primarily interested in birds, collected a few specimens of mammals in Oklahoma which are deposited in the Carnegie Museum of Natural History. In the spring of 1937, George H. Lowery collected a few mammals in Oklahoma for the Louisiana State University Museum. In the summer of 1938, H. D. Chase, of the University of Tulsa, collected mammals in northern Oklahoma. During the past 7 years the author has, at various times, collected mammals in Oklahoma. During this time, intensive collecting was done only in the northern part of the main section of the state, and an extensive reconnaissance of mammalian distribution in the Panhandle and in the southern part of the state was made. Most of the specimens collected during this time are deposited in the University of Michigan, Museum of Zoology, but a few are in the collection of the University of Tulsa.

The present paper presents a list of the 99 species and races of recent, native mammals known to occur in Oklahoma. The institution in which each available specimen of Oklahoma mammal is deposited is indicated, or in the case of published records the author responsible for the record is cited.

All of the specimens of Oklahoma mammals known to the author, except some specimens in the collection of the United States Bureau of Biological Survey which he did not have the opportunity to examine, are recorded here. The specimens examined or recorded are deposited in 11 scientific institutions, which are listed below with the symbol used to indicate each in the text.

American Museum of Natural History	AM
Carnegie Museum	CM
Colorado Museum of Natural History	CMNH
Field Museum of Natural History	FM
University of Kansas, Museum of Birds and Mammals	KU
Louisiana State University Museum	LSU
University of Michigan, Museum of Zoology	UM
Museum of Comparative Zoology	MCZ
Oklahoma Agricultural and Mechanical College	OAMC
University of Oklahoma	OU
University of Tulsa	TU

It has been possible to examine most of the specimens of Oklahoma mammals, but in a few cases lists of large species that could not be easily shipped were kindly furnished by those in charge of the collections. In the text, italicized symbols are used to indicate the institutions in which these specimens are deposited. A few reliable sight records are included, although no attempt has been made to list all of those available. The observers and the symbols used to indicate them are:

W. Frank Blair	WFB
H. D. Chase	HDC
George H. Lowery	GHL
George A. Moore	GAM

The author realizes that the material on which this report is based does not give a complete picture of mammalian distribution in Oklahoma. However, it is hoped that its publication will stimulate further work on the mammals of the state.

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Biotic Districts in Oklahoma

The distribution of mammals in Oklahoma is particularly interesting because 3 major biotic areas occur in the state. In approximately the eastern one-third of Oklahoma forests predominate, and the area, therefore, is a part of the extensive deciduous forest of eastern North America. In all of the rest of the state, except the northwestern tip of the Panhandle, grassland is the principal vegetation type, and the area, therefore, is part of the grasslands of the Great Plains.[1] In the northwestern corner of the Panhandle, brush and forest associations typical of the southern Rocky Mountains occur, and indicate the close relationship of that area to the southern Rocky Mountain region.

[1] The Great Plains are here considered to extend eastward to the boundary proposed by Bollinger (1926: 123).

The biotic districts in Oklahoma assigned to the eastern deciduous forest are the Mississippi, Ouachita, Ozark, and Cherokee Prairie districts (Fig. 1). The Osage Savanna district is transitional between the eastern deciduous forest and the Great Plains grasslands, but is here included with the eastern deciduous forest. The districts assigned to the Great Plains grasslands are the Mixed-grass Plains, Mesquite Plains, Wichita Mountain, and Short-grass Plains districts. The district with southern Rocky Mountain affinities is the Mesa de Maya district. The biotic districts of Oklahoma already have been described (Blair and Hubbell, 1938).

The biotic district is considered by the author to be the most natural geographic unit in mammalian distribution, and in this report the distribution of the mammals in the biotic districts in Oklahoma is indicated by the available records.

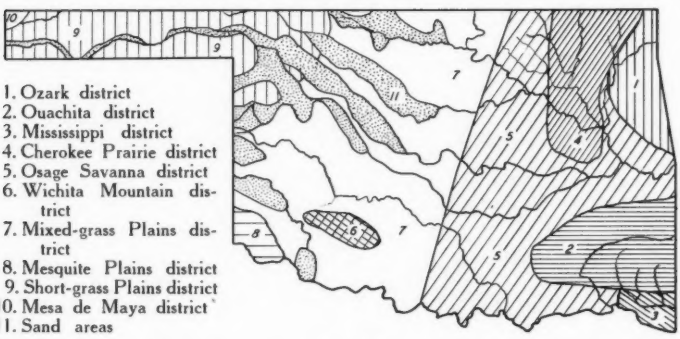

Fig. 1. Map of the biotic districts in Oklahoma (after Blair and Hubbell).

Faunal Relationships of the Mammals

Three major mammalian faunas are represented in Oklahoma, one of them centering in each of the major biotic areas in the state. In the area covered by the Mississippi, Ouachita, Ozark, Cherokee Prairie, and Osage Savanna districts of the eastern deciduous forest, the mammals present are mostly those characteristic of the eastern deciduous forest, although, in the Cherokee Prairie and Osage Savanna districts (Table 2) there is a considerable element of Great Plains grasslands species.[2] In the area covered by the Mixed-grass Plains, Short-grass Plains, Mesquite Plains, and Wichita Mountain districts of the Great Plains grasslands, a Great Plains mammalian fauna predominates, althought there is a considerable element of eastern deciduous forest species and a slight element of southern Rocky Mountain species. In the Mesa de Maya district, which is most closely related to the southern

[2] A few of the mammals included here have ranges that extend westward and southwestward beyond the Great Plains grasslands.

TABLE 1. Distribution of the species and races of mammals in Oklahoma by biotic districts. x indicates that the species or race has been recorded from the district; † indicates that it is endemic in Oklahoma to the district; ‡ indicates that it occurs only in the edge of the district; ? indicates that it probably occurs in the district; ?? indicates that it probably occurred there in the past but is now extirpated there.

	Major Biotic Areas									
	Eastern Deciduous Forest					Great Plains Grasslands				South. Rocky Mts.
	Biotic Districts									
Species	Mississippi	Ouachita	Ozark	Cherokee Prairie	Osage Savanna	Mixed-grass Plains	Short-grass Plains	Mesquite Plains	Wichita Mountain	Mesa de Maya
Didelphis virginiana virginiana	x	x	x	x	x	x			x	
Scalopus aquaticus pulcher	x	x	x		‡					
Scalopus aquaticus intermedius				x	x	x	‡	x	x	
Scalopus aereus			†							
Cryptotis parva	x	?	?	x	x	x			x	
Blarina brevicauda carolinensis	?	?	?	x	x	‡				
Blarina brevicauda hulophaga					†					
Myotis velifer incautus						x	?	?	x	?
Myotis grisescens			†							
Myotis subulatus melanorhinus										†
Pipistrellus subflavus subflavus	x	x	x	x	x					
Eptesicus fuscus fuscus	?	x	?	x	?					
Eptesicus fuscus pallidus						x	?	?	?	?
Lasiurus borealis borealis	x	x	x	x	x	x				
Lasiurus cinereus	?	?	?	?	?	x	?	?	?	
Nycticeius humeralis	x	x			‡					
Corynorhinus rafinesquii rafinesquii		†								
Corynorhinus rafinesquii pallescens						x	?	?	?	?
Antrozous pallidus										†
Tadarida mexicana						x	?	?	?	?
Euarctos americanus americanus	??	??	??	??	x	??	??	??	x	??
Procyon lotor hirtus	?	?	x	?	x	x	?	?	x	?
Mustela frenata primulina			?	?	?	x				
Mustela vison mink			x	x	x					
Mustela vison letifera						x				
Lutra canadensis lataxina	??	??	?	??	??	??	x	??	??	??
Spilogale interrupta	?	?	?	x	x	x	?	?	x	
Mephitis mephitis mesomelas	x	x	x	x	x	x				
Mephitis mephitis varians						x	x	?	x	?

TABLE 1 (Continued)

Taxidea taxus berlandieri						x	x	?	?	?
Vulpes fulva		?	x							
Vulpes velox velox						x	?	?	?	?
Urocyon cinereoargenteus ocythous	?	?	x							
Canis latrans nebrascensis						x	x			
Canis latrans texensis						?		?	x	
Canis rufus rufus					x	x				
Canis lupus nubilus						x	x	??	x	??
Felis concolor	??	??	??	??	??	x	??	??	??	??
Lynx rufus baileyi						x	?	?	?	?
Marmota monax monax		?	x							
Citellus variegatus grammurus							x			x
Citellus spilosoma major						x	x	?	?	
Citellus tridecemlineatus texensis				x	x	x			x	
Citellus tridecemlineatus arenicola						‡	x			
Cynomys ludovicianus ludovicianus						x	x	x	x	x
Eutamias quadrivittatus quadrivittatus										†
Tamias striatus venustus		x	x		‡					
Sciurus carolinensis carolinensis	x	?	x	x	x					
Sciurus niger rufiventer	x	x	x	x	x	x			x	
Glaucomys volans saturatus	?	?	x	x	?	‡				
Geomys breviceps breviceps	x			x	x					
Geomys breviceps llanensis					‡	x	?	x	?	
Perognathus flavescens copei						x	?			x
Perognathus flavus flavus						x	x	x	?	x
Perognathus hispidus paradoxus						‡	x	x	?	?
Perognathus hispidus spilotus				x	x	x				
Dipodomys elator						†				
Dipodomys ordii richardsoni						x	x	x	?	?
Castor canadensis	??	??	??	??	x	??	x	??	??	??
Onychomys leucogaster articeps							x			x
Onychomys leucogaster breviauritus						x		x	?	
Reithrodontomys montanus griseus				x	x	x	x	?	?	
Reithrodontomys fulvescens intermedius									†	
Reithrodontomys fulvescens aurantius	x	x	x		x					
Peromyscus maniculatus osgoodi										†
Peromyscus maniculatus nebrascensis						x	x	x	x	
Peromyscus maniculatus ozarkiarum		x	x	x	x	‡				
Peromyscus leucopus leucopus		x			x					
Peromyscus leucopus noveboracensis			x	x	x	‡				
Peromyscus leucopus tornillo							?	x		x
Peromyscus leucopus texanus						x			x	
Peromyscus gossypinus megacephalus	x	x								
Peromyscus boylii rowleyi										†
Peromyscus boylii attwateri		x	x	x	x				x	

TABLE 1 (Continued)

Peromyscus truei truei										†
Peromyscus nasutus nasutus										†
Peromyscus nuttalli aureolus	x	x			‡					
Oryzomys palustris texensis	†									
Sigmodon hispidus texianus	x	x	x	x	x	x			x	
Neotoma floridana osagenis	x	x	x	x	x	x			x	
Neotoma micropus micropus						x		x	?	
Neotoma micropus canescens							†			?
Neotoma albigula warreni										†
Neotoma mexicana fallax										†
Microtus ochrogaster				x	?	x				
Pitymys nemoralis			x	x	x	‡			x	
Ondatra zibethica cinnamomina				x	x	x	?	?	?	?
Zapus hudsonius campestris				†						
Erethizon epixanthum bruneri							?			†
Lepus californicus melanotis				x	x	x	x	x	x	?
Sylvilagus floridanus alacer	x	x	x	x	x	‡				
Sylvilagus floridanus llanensis						x	x	x	x	
Sylvilagus audubonii neomexicanus						x	x	x	x	x
Sylvilagus aquaticus aquaticus	x	x	?	x	x	‡				
Cervus merriami									†	
Odocoileus virginianus macrourus					??	x	x	??	x	??
Antilocapra americana americana						x	x	??	??	??
Bison bison bison						x	x	??	??	??
Dasypus novemcinctus texanus				x	x					

Rocky Mountains, a southern Rocky Mountain fauna predominates, although there is a considerable element of Great Plains grassland species.

The mammalian fauna of each biotic district in Oklahoma shows some differences from the fauna of every other district in the state, although adjacent districts in a major biotic area often have many species of mammals in common. The districts also are characterized by their respective patterns of mammalian distribution. These result from differences in the pattern of distribution of ecological associations within the various districts. The pattern of distribution of ecological associations is, in turn, controlled largely by edaphic factors.

The Mississippi district has a known fauna of 18 species and races, all of which have their affinities with the fauna of the eastern deciduous forest (Table 1). Of the 18, only the rice-rat is restricted in Oklahoma to the Mississippi district, and the cotton-mouse is known only from the Mississippi and Ouachita districts. The evening-bat and golden-mouse extend into the Ouachita district and into the area of Osage Savanna district in the lower Arkansas Valley. The other species and races extend into most of the other eastern forest districts in Oklahoma.

The Ouachita district has a known fauna of 20 species and races. Of these, 19 (95%) have their affinities with the fauna of the eastern deciduous

Table 2. Faunal relationships of the species and races of mammals in the biotic districts of Oklahoma.

Biotic Districts	Species and races having affinities with fauna of eastern deciduous forest.	Affinities mostly with fauna of Great Plains grasslands.	Affinities with fauna of southern Rocky Mountains.	Southern affinities.	Endemic	Widely distributed	Totals
Mississippi	18						18
Ouachita	19	1					20
Ozark	22	1			1		24
Cherokee Prairie	20	9		1			30
Osage Savanna	25	10		1	1	1	38
Mixed-grass Plains	17	37				2	56
Wichita Mountain	8	16	1				25
Mesquite Plains		13					13
Short-grass Plains		21	1			2	24
Mesa de Maya		6	11				17

forest, and one (5%) has affinities with the southern Great Plains fauna. The latter, the brush mouse, is a saxicolous form that occupies brush and wooded ravines in the southern Great Plains and extends into the Ozark district in a similar habitat type. Of the eastern deciduous forest species and races, an eastern forest race of the long-eared bat is known in Oklahoma only from the Ouachita district. One species, the cotton-mouse, is known in Oklahoma only from this and the Mississippi district. A race of the wood-mouse occurs in the state only in this district and in nearby parts of the Osage Savanna district. Two of the species, the evening-bat and golden-mouse, are known in Oklahoma only from the Ouachita and Mississippi districts and from adjacent parts of the Osage Savanna district. One of the species, the eastern chipmunk, is known in Oklahoma only from the Ouachita and Ozark districts and from the nearby parts of the Osage Savanna district. The 13 other eastern deciduous forest species and races occur in most of the eastern forest districts. Mesic forest inhabiting mammals that are relatively evenly distributed in the forests of the Mississippi district are limited in the Ouachita district to mesic flood-plains and ravines.

The Ozark district has 24 species and races, of which 22 (92%) have affinities with the eastern deciduous forest fauna, one (4%) is an endemic species, the golden mole, of which the type is unique, as now recognized, although subsequent work possibly will prove it to be synonymous with an eastern forest race of the eastern mole, and one (4%) has affinities with

the southern Great Plains fauna. The last is the same race of the saxicolous brush mouse that occurs in rocky ravines in the Ouachita district, and it occupies a similar type of habitat in the Ozark district. Of the 22 eastern deciduous forest species and races, the gray bat, red fox, gray fox, and woodchuck, are now known in Oklahoma only from the Ozark district, and one, the eastern chipmunk, is known only from the Ozark and Ouachita districts and nearby parts of the Osage Savanna district. The forest fauna is fairly continuously distributed over the Ozark district, although some species with preferences for mesic situations are more or less restricted to moist ravines and flood-plains.

The Cherokee Prairie district has a mammalian fauna of 30 species and races. Of these, 20 (67%) have affinities with the fauna of the Great Plains grasslands, one (3%) is a southern species, the nine-banded armadillo, that reaches the northern limit of its range in the district. Of the 9 Great Plains grasslands species and races, 7 reach their eastern limits in this district. One of the 7 is a northern Great Plains race of the boreal jumping mouse that reaches its southern limit in the district. In the Cherokee Prairie district, the eastern deciduous forest species and races are largely restricted to the woodlands of the stream valleys and associated ravines, while the Great Plains grasslands species and races occupy the grasslands which cover most of the area.

The Osage Savanna district has a mammalian fauna of 38 species and races. Of these, 25 (65%) have affinities with the fauna of the eastern deciduous forest, 10 (26%) have affinities with the fauna of the Great Plains grasslands, one (3%) is a widely distributed species, the beaver, and one (3%) is a race of the sylvan shrew that, as now known, is endemic to the southern part of the district. Of the 25 eastern deciduous forest species and races, 10 reach their western limits in the Osage Savanna district. Of the Great Plains grasslands element in the fauna, a race of the red wolf and one of the pocket-gopher reach their eastern limit in the district. In the Osage Savanna district, the eastern forest faunal element occupies the blackjack association on the sandstone ridges and the oak—elm association of the stream systems, although some eastern species occur occasionally in the grasslands. The Great Plains grasslands element occupies the grasslands, which cover roughly one-half of the area of the district.

The Mixed-grass Plains district has a mammalian fauna of 56 species and races. Of these, 17 (30%) have affinities with the fauna of the eastern deciduous forest, 37 (66%) have affinities with the Great Plains grasslands fauna, and 2 (4%) are widely distributed species, the hoary bat and cougar. None of the 17 eastern deciduous forest species and races extends westward beyond this district. Of the 37 Great Plains species and races, 27 reach their eastern limits in this district, and 9 extend eastward into the Osage Savanna district. One Great Plains species, the plains kangaroo rat, is endemic to the southern part of the Mixed-grass Plains district. The Great Plains element in the fauna of the district is distributed over the grasslands which cover most of the area of the district, while the eastern forest element is

largely restricted to narrow areas of forest and brush adjacent to the streams.

The Wichita Mountain district has a known fauna of 25 species and races, of which 8 (32%) have eastern forest affinities, 16 (64%) have Great Plains affinities, and one (4%), the elk, has southern Rocky Mountain affinities. A Great Plains race of the golden harvest-mouse is known in Oklahoma only from this district. The eastern forest element in the fauna occupies the oak forests of the mountain slopes and the oak—elm forest of the flood-plains, while the Great Plains element is largely confined to the grasslands that alternate with the wooded peaks.

The Mesquite Plains district has a known mammalian fauna of 13 species and races, but subsequent work undoubtedly will add others to the list. All of the species and races known from the Mesquite Plains district have their affinities with the fauna of the Great Plains grasslands. A race of the wood-mouse reaches the eastern limits of its range in the district.

The Short-grass Plains district has a known mammalian fauna of 24 species and races, of which 21 (88%) have affinities with the Great Plains fauna, one (4%), the rock squirrel, has affinities with the fauna of the southern Rocky Mountains, and 2 (8%) are widely distributed species, the otter and beaver. Of the 21 Great Plains species and races, a race of the grasshopper-mouse and one of the plains woodrat do not extend eastward into the Mixed-grass Plains district, and 15 species and a race of the deermouse have not been taken in the Mesa de Maya district to the west, although some of them probably will be found to occur there. In the Short-grass Plains district, the Great Plains faunal element is distributed over the area, while the one southern Rocky Mountain form undoubtedly enters the district by way of rocky bluff bordering the streams.

The Mesa de Maya district has a known mammalian fauna of 17 species and races, but subsequent work undoubtedly will add others to the list. Of the 17 species and races, 11 (65%) have affinities with the fauna of the southern Rocky Mountains, and 6 (35%) have affinities with the fauna of the Great Plains grasslands. Of the 11 southern Rocky Mountain species and races, only the rock squirrel is known to extend eastward into the Short-grass Plains district. One race of the wood-mouse occurs also in the Mesquite Plains district, and the other 9 are known in Oklahoma only from the Mesa de Maya district. In the Mesa de Maya district, the southern Rocky Mountain faunal element is largely confined to rocky and brushy canyons and slopes, while the Great Plains element occurs in the same situations and on the level, arid grasslands on top of the mesas.

Factors in Mammalian Distribution

In Oklahoma, the distribution of mammals is mostly correlated with the distribution of vegetation types which in turn is largely correlated with the amount of rainfall. It is obvious from the above discussion of the faunal relationships of the mammals that the eastern deciduous forest species and races tend to reach the western limits of their ranges at the western limits of the

eastern forest districts, for the Great Plains species and races to reach their eastern limits at the eastern limits of the Great Plains grassland districts, and for the southern Rocky Mountain species and races to reach their eastern limits at the eastern boundary of the Mesa de Maya district. Because the forest species and races generally fail to extend westward into the grasslands of the Great Plains it is assumed that for the most part these grasslands are a barrier to the distribution of the forest mammals. Likewise, the eastern forest is assumed to be a barrier to the eastward distribution of the Great Plains grasslands mammals, and the Great Plains grasslands a barrier to the eastward distribution of the southern Rocky Mountain forest mammals.

Certain of the mammals extend beyond the areas of their particular vegetation type into areas mostly occupied by vegetation types that are considered to be barriers to them. Thus, 17 eastern forest species and races occur in the Mixed-grass Plains district of the Great Plains grasslands; 9 Great Plains species and races occur in the Cherokee Prairie district and one in the Ozark and Ouachita districts; and two southern Rocky Mountain mammals extend into the Great Plains grasslands. The seemingly anamolous distribution of these mammals is largely the result of ecological features associated with the stream systems of the state. Six major stream systems extend across most of the state from west to east. In the relatively deep, relatively moist, alluvial soils of the stream flood-plains, the oak—elm flood-plain forest of the eastern forest districts extends westward beyond the climatic limits of the eastern forest into the Mixed-grass Plains district of the Great Plains grasslands. These relatively narrow strips of forest in an area predominantly grassland are highways by which some of the eastern forest mammals extend westward beyond the eastern forest districts. The oak—elm forest of the Mixed-grass Plains district becomes more and more restricted and arid with decreasing rainfall westward, and the eastern forest mammals which reach their respective western limits at various places in the district apparently reach them where the aridity and sparsity of the forest exceeds their respective toleration limits. Other features of the stream systems than the flood-plain forest largely control the distribution of some mammals. The presence of water permits the distribution of semi-aquatic mammals along the stream systems. Rocky Bluffs bordering many of the streams are highways for the distribution of saxicolous mammals, and it is by way of these that the one Great Plains race of a saxicolous species is believed to extend into the Ozark and Ouachita districts of the eastern forest. The soil of the flood-plains is deeper, more moist and more loose, and, therefore, more easily worked by burrowing mammals than that of the uplands. Therefore, some mammals, such as the mole *(Scalopus aquaticus)*, are distributed along the stream flood-plains.

In the western half of the Mixed-grass Plains district and in the districts to the west of it, many of the streams are bordered by extensive sand dunes. The five-toed kangaroo rat *(Dipodomys ordii)* is almost entirely confined to these areas of sandy soil. It is assumed, therefore, that this species requires such soil. It possibly would not be able to burrow in heavier soil. The mole

likewise finds a suitable habitat in the sandy soil. Such forest forms as the wood-mouse and eastern cottontail occur in the brush associations that occupy parts of the sand areas.

The Great Plains grasslands mammals that extend eastward into the Cherokee Prairie district of the eastern forest are mostly limited there to areas of thin, relatively arid, limestone soil, where the vegetation is of types similar to those of the Great Plains grasslands.

It is desirable to consider here the possible importance of temperature as a factor in the distribution of mammals in Oklahoma, since the "Life Zone theory," which holds temperature to be the critical factor in the distribution of mammals, has been widely used by Merriam (1892) and others in describing the distribution of mammals, has been widely used by Merriam (1892) and others in describing the distribution of mammals in North America. Ninety-nine species and races have been recorded from Oklahoma. Two of these are endemic, so far as now known. Of the remaining 97 species and races, 86 (89%) reach either eastern or western limits or both in Oklahoma, while only 17 (18%) reach northern or southern limits in the state. It is at once evident that the north—south zonation in the mammalian fauna, which might possibly be attributable to the effects of temperature, is far overshadowed by the east—west zonation, which results indirectly from differences in the amount of rainfall.

Briefly, the mammalian fauna of Oklahoma shows marked east—west zonation, with each of the 3 major biotic areas in Oklahoma characterized by a distinctive mammalian fauna. The fauna of each biotic area is largely confined to its own biotic area, but some species and races in each extend into the adjoining biotic area. This extension of certain mammals beyond their respective biotic areas is made possible by the existence of highways for distribution, of which the most important are the stream systems that cross the state in an east—weste direction. Temperature is believed to be of little importance as a factor influencing the distribution of mammals in Oklahoma.

Annotated List of Mammals

In the following list, the taxonomic arrangement of the species and subspecies follows Miller (1924) in general, but a few changes, which are indicated in the text, have been made, and several subspecies subsequently have been described. No attempt has been made to include the synoymy under the species and subspecies, and as a rule only synonyms that have been described from Oklahoma are listed. In this report, only the distribution of the mammals in Oklahoma is given, although most of the species have ranges that extend beyond the boundaries of the state.

Didelphis virginiana virginiana Kerr.—OPOSSUM.

1792. *Didelphis virginiana* Kerr, Anim. Kingd.: 193 (*fide* Miller, 1924: 3).

Type locality.—Virginia.

Distribution.—Most of Oklahoma except the Panhandle. Recorded from

the Mississippi, Ouachita, Ozark, Cherokee Prairie, Osage Savanna, Wichita Mountain, and Mixed-grass Plains biotic districts.

Records.—Adair Co. *(KU);* Alfalfa Co., Clay Creek (Jackson and Warfel, 1933: 66) Cleveland Co., Norman (OU), 3 miles southeast of Norman *(KU);* Comanche Co., Wichita National Forest *(KU);* Dewey Co., *(KU);* Major Co., Cleo Springs (Jackson and Warfel, 1933: 66); Mayes Co., Locust Grove (WFB); McCurtain Co., 15 miles southeast of Broken Bow and 2 miles west of Smithville (OU); Noble Co., 2 miles south of Billings (OAMC); Okfuskee Co., 2 miles west of Okemah (OU); Payne Co., 2 miles west of Stillwater (OAMC); Pottawatomie Co., 7 miles southeast of Tecumseh *(KU);* Rogers Co., Garnett (Blair, 1938: 494); Tulsa Co., Mohawk Park and Tulsa *(idem);* Woods Co., Cimarron River and Dog Creek (Jackson and Warfel, 1933: 66).

Remarks.—This semi-arboreal species enters Oklahoma from the east and extends westward across the state along wooded stream valleys.

Scalopus aquaticus pulcher Jackson.—EASTERN MOLE.

1914. *Scalopus aquaticus pulcher* Jackson, Proc. Biol. Soc. Washington **27**:20.

Type locality.—Delight, Pike County, Arkansas.

Distribution.—Forests of extreme eastern Oklahoma. Recorded from the Ozark, Ouachita, and Mississippi biotic districts, and from the southeastern part of the Osage Savanna district.

Records.—Adair Co., 2 miles west of Stilwell (UM); Bryan Co., 3 miles east of Yuba (UM); Cherokee Co., Scraper and 2 miles southeast of Lowery (UM); Le Flore Co., one mile southwest of Summerfield (UM), Wister (CM); McCurtain Co., Glover (UM).

Remarks.—The rich, dark color of this race apparently is correlated with the dark color of the humus-laden soils in which it lives. This animal is most abundant in alluvial soils, but in the Ozark district its burrows may often be seen in the thin soil of chert-mantled hillslopes and in the thin soil of upland ravines. In the Mississippi district in August, 1937, numerous mole burrows were observed in sandy alluvium supporting yellow pine and sweetgum.

Scalopus aquaticus intermedius (Elliot).—EASTERN MOLE.

1899. *Scalops machrinus intermedius* Elliot, Field Columb. Mus., publ. 37, zool. ser. **1**:280.

Type locality.—Alva, Woods County, Oklahoma.

Distribution.—Approximately the western two-thirds of Oklahoma except the Panhandle. Recorded from the Mixed-grass Plains, Mesquite Plains, Short-grass Plains, Wichita Mountain, Osage Savanna, and Cherokee Prairie biotic districts.

Records.—Canadian Co., Fort Reno (Jackson, 1915: 50); Cleveland Co., Norman (KU, OU); Comanche Co., Mount Scott (Jackson, 1915: 50); Dewey Co., 5 miles southwest of Canton (KU); Ellis Co., Packsaddle Lake (CM); Harmon Co., Buck Creek, extreme southwest corner of state (UM); Harper Co., 4 miles north of Laverne (UM); Jackson Co., 14 miles south of Olustee (UM); Major Co., 9 miles southwest of Togo (UM); McClain Co., 10 miles southwest of Norman (OU); Murray Co., Dougherty (Jackson, 1915: 50); Muskogee Co., 3 miles east of Wainwright (OU); Noble Co., Morrison (OAMC); Osage Co., 10 miles northwest of Pawhuska (UM); Payne Co., Stillwater (OAMC); Pottawatomie Co., Tecumseh (KU and OAMC);

Rogers Co., Garnett (Blair, 1938: 495); Tulsa Co., Mohawk Park *(idem)*, Red Fork (Jackson, 1915: 50); Woods Co., Alva *(idem)*, 4 miles south of Waynoka (TU).

Remarks.—This pale race of the eastern mole is widely distributed in the sand dunes along many of the streams in the Mixed-grass Plains district and follow the dunes for some distance into the Short-grass Plains district. Specimens from the Osage Savanna district average considerably darker than typical *intermedius*, but seem best referred to this race. The specimen from Osage County is very rich in color, thus approaching *pulcher*. The specimens examined from Tulsa and Rogers counties are intermediate between *intermedius* and *pulcher*.

Scalopus aereus (Bangs).—Golden Mole.

1896. *Scalops texanus aereus* Bangs, Proc. Biol. Soc. Washington **10**:138.

Type locality.—Stilwell, Adair County, Oklahoma.

Distribution.—Known only from the type locality.

Record.—One, the type (MCZ).

Remarks.—The status of *Scalopus aereus*, which is based on a single specimen, has long been in doubt. The recent taking of specimens referable to *Scalopus aquaticus pulcher* near Stilwell adds further to the doubt about the status of *aereus*. One of these specimens was compared with the type of *aereus* by Glover M. Allen, who is of the opinion that the type of *aereus* probably is a slightly aberrant individual of the form later described as *pulcher*. Only the collection of additional specimens from the vicinity of Stilwell will settle the question. In the event that *aereus* and *pulcher* are found to be the same form, the name *aereus*, by priority, will supplant *pulcher*, and the correct name for the richly colored mole of eastern Oklahoma will be *Scalopus aquaticus aereus*.

Cryptotis parva (Say).—Little Shrew.

1823. *Sorex parvus* Say, Long's Exped. to Rocky Mts. **1**:163 (*fide* Miller, 1924:31).

Type locality.—West bank of Missouri River, near Blair, formerly Engineer Cantonment, Washington County, Nebraska.

Distribution.—Approximately the eastern two-thirds of Oklahoma. Recorded from the Mississippi, Cherokee Prairie, Osage Savanna, Wichita Mountain, and Mixed-grass Plains biotic districts.

Records.—Cleveland Co., Norman (OU); Comanche Co., Wichita National Forest (OU); McClain Co., 7 miles south of Norman (OU); McCurtain Co., 2 miles west of Eagletown (UM); Muskogee Co., 6 miles southeast of Muskogee (OU); Payne Co., Stillwater (OAMC); Pottawatomie Co., 7 miles southeast of Tecumseh (KU); Rogers Co., Garnett (Blair, 1938:495); Tulsa Co., Tulsa *(idem)*.

Remarks.—The little shrew occurs in two color phases. Of the 5 specimens from Stillwater, 4 were in the brown phase, and the other was in the gray phase. All of the 9 specimens from Norman were in the brown phase. This shrew occupies grassland habitats wherever it is known to occur in Oklahoma.

Blarina brevicauda carolinensis (Bachman).—SYLVAN SHREW.

1837. *Sorex carolinensis* Bachman, Journ. Acad. Nat. Sci. Philadelphia **7**(2):366.

Type locality.—Eastern South Carolina.

Distribution.—Approximately the eastern half of Oklahoma except the Arbuckle Mountain region. Recorded from the Cherokee Prairie and Osage Savanna biotic districts, and from the eastern edge of the Mixed-grass Plains district, but probably occurs also in the Ozark, Ouachita, and Mississippi districts.

Records.—Cleveland Co., Norman (OU); McClain Co., 7 miles south of Norman (OU); Osage Co., Conway Springs (TU); Tulsa Co., Mohawk Park (Blair, 1938: 495).

Remarks.—The sylvan shrew inhabits the most mature parts of the oak—elm flood-plain forest. Specimens from the northern part of the Osage Savanna district are clearly referable to *carolinensis* rather than to the subspecies *hulophaga* of the Arbuckle Mountains in the southern part of the district.

Blarina brevicauda hulophaga Elliot.—SYLVAN SHREW.

1899. *Blarina brevicauda hulophaga* Elliot, Field Columb. Mus. publ. 38, zool. ser., **1**:287.

Type locality.—Dougherty, Murray County, Oklahoma.

Distribution.—Known only from the Arbuckle Mountains in the southern part of the Osage Savanna biotic district.

Records.—Murray Co., Arbuckle Mountains (CM), Dougherty (FM), Sulphur (OAMC).

Remarks.—This race is known from only 4 specimens, all of which agree in being paler and more brownish in color than the race *carolinensis*. In size and cranial characters it does not differ appreciably from *carolinensis*. It seems likely that this is a slight local race, developed through partial isolation in the Arbuckle Mountains.

Myotis velifer incautus (Allen).—WESTERN CAVE BAT.

1896. *Vespertilio incautus* Allen, Bull. Amer. Mus. Nat. Hist. **8**:239.

Type locality.—San Antonio, Bexar County, Texas.

Distribution.—Western half of main part of Oklahoma. Recorded only from the Mixed-grass Plains and Wichita Mountain biotic districts, but undoubtedly occurs where there are caves in the Mesquite Plains, Short-grass Plains, and Mesa de Maya districts.

Records.—Blaine Co. (OU), Salt Creek Canyon, 4 miles southeast of Southard (KU); Canadian Co., Fort Reno (Miller and Allen, 1928: 93); Comanche Co., Cache Creek *(idem)*; Dewey Co., 5 miles north, 5 miles west of Canton (KU); Garfield Co., Enid (KU); Major Co., 12 miles south of Waynoka, Woods Co. (OAMC), Graver Creek, 9 miles southwest of Togo (UM); Woods Co., Waynoka (KU); Woodward Co., 10 miles south of Freedom (UM).

Remarks.—This common cave bat of western Oklahoma apparently does not extend east of the eastern boundary of the Mixed-grass Plains biotic district.

In assigning the race *incautus* to the species *velifer*, the author follows Miller and Allen (1928: 92).

Myotis grisescens Howell.—GRAY BAT.

1909. *Myotis grisescens* Howell, Proc. Biol. Soc. Washington **22**:46.

Type locality.—Nickajack Cave, near Shellmound, Marion County, Tennessee.

Distribution.—Northeastern corner of Oklahoma. Recorded only from the Ozark biotic district.

Records.—Adair Co., 5 miles south of Kansas (UM); Cherokee Co., Scraper (UM).

Remarks.—This cave bat probably does not range west of the Ozark district. It is very numerous in the limestone caves of that district, where it often is associated with the pipistrelle *(Pipistrellus subflavus subflavus)*. The species has not previously been recorded from Oklahoma.

Myotis subulatus melanorhinus (Merriam).—LITTLE BROWN BAT.

1890. *Vespertilio melanorhinus* Merriam, North Amer. Fauna **3**:46.

Type locality.—Little Spring, north base of San Francisco Mountain, Coconino County, Arizona, altitude 8250 feet.

Distribution.—Western tip of Oklahoma Panhandle. Recorded only from the Mesa de Maya biotic district.

Records.—Cimarron Co., 3 miles north of Kenton (UM).

Remarks.—The single specimen of this species known from Oklahoma was shot at dusk in a brushy, rocky ravine on the slopes of the Mesa de Maya.

In assigning the race *melanorhinus* to the species *subulatus*, the author follows Miller and Allen (1928: 169).

Pipistrellus subflavus subflavus (F. Cuvier).—PIPISTRELLE.

1832. *V[espertilio] subflavus* F. Cuvier, Nouv. ann. mus. hist. nat. Paris **1**:17.

Type locality.—Eastern United States, probably Georgia.

Distribution.—Approximately the eastern half of Oklahoma. Recorded from the Mississippi, Ouachita, Ozark, Cherokee Prairie, and Osage Savanna biotic districts.

Records.—Adair Co., 5 miles south of Kansas and 9 miles south of Stilwell (UM). Stilwell (Miller, 1897: 92); 7 miles west of Stilwell (KU); Cherokee Co., Scraper (UM); Le Flore Co., 6 miles west of Heavener and 1 mile northeast of Zoe (OU); McCurtain Co., 14 miles southeast of Broken Bow (OU), 6 miles south of Tom (UM), Red River, 1 mile west of Oklahoma—Arkansas line (Ortenburger, 1926:122); Murray Co., 10 miles south and 2 miles east of Sulphur (OU); Rogers Co., 3 miles northeast of Garnett (Blair, 1938:496).

Remarks.—The pipistrelle is a cave bat in Oklahoma, and its distribution in eastern Oklahoma probably is correlated with the distribution of caves.

Eptesicus fuscus fuscus (Beauvois).—Big Brown Bat.

1796. *Vespertilio fuscus* Beauvois, Catal. Raisonné Mus. Peale, Philadelphia: 18 (*fide* Miller, 1924: 76).

Type locality.—Philadelphia, Pennsylvania.

Distribution.—Probably the eastern half of the main part of Oklahoma, but recorded only from the Ouachita and Cherokee Prairie biotic districts.

Records.—Le Flore Co., Houston (OU); McCurtain Co., 2 miles west of Smithville (OU); Tulsa Co., Tulsa (Blair, 1938: 496).

Remarks.—This is the species most commonly found in houses in eastern Oklahoma, but it also occurs occasionally in caves. No specimens of the big brown bat have previously been recorded from Oklahoma.

Eptesicus fuscus pallidus Young.—Big Brown Bat.

1908. *Eptesicus pallidus* Young, Proc. Acad. Nat. Sci. Philadelphia: 408.

Type locality.—Boulder, Boulder County, Colorado.

Distribution.—Probably all of Oklahoma west of the Osage Savanna biotic district, but recorded only from the Mixed-grass Plains district.

Records.—Woods Co., Freedom (Jackson and Warfel, 1933: 67), Marehew Cave, one-half mile south of Oklahoma—Kansas line (KU).

Remarks.—The specimens examined from Marehew Cave are referred to the race *pallidus*, so the specimen recorded from Freedom by Jackson and Warfel, although not examined, is included here with that race.

Lasiurus borealis borealis (Müller).—Red Bat.

1776. *Vespertilio borealis* Müller, Natursyst. Suppl.: 20 (*fide* Miller, 1924: 78).

Type locality.—New York.

Distribution.—Most of the main part of Oklahoma. Recorded from the Ozark, Ouachita, Mississippi, Cherokee Prairie, Osage Savanna, and Mixed-grass Plains biotic districts.

Records.—Blaine Co. (OU); Bryan Co., 3 miles southeast of Yuba (UM); Cherokee Co., Scraper (TU); Cleveland Co., Norman (KU); Dewey Co., 10 miles northwest of Canton (KU); Garfield Co., 2 miles east of Enid (KU); Hughes Co., 2 miles north Calvin (UM); Kay Co., Ponca City (Miller, 1897: 108); Latimer Co., Wilburton (OU); McCurtain Co., 14 miles southeast of Broken Bow (OU), Glover and 6 miles south of Tom (UM); Osage Co., 2 miles southwest of Okesa (UM); Payne Co., Stillwater (OAMC); Pittsburg Co., Harshorne (Miller, 1897: 108); Rogers Co., 2 miles north of Garnett (Blair, 1938: 496); Tulsa Co., Tulsa (*idem*); Sequoyah Co., Redland (Miller, 1897: 108); Woods Co., Waynoka (Jackson and Warfel, 1933: 67).

Remarks.—This tree bat is abundant in the Ozark, Ouachita, and Mississippi districts, in which forests prevail. With the decrease of forests westward the red bat becomes rare.

Lasiurus cinereus (Beauvois).—Hoary Bat.

1796. *Vespertilio cinereus* (misspelled *linereus*) Beauvois, Catal. Raisonné Mus. Peale, Philadelphia: 18 (*fide* Miller, 1924: 79).

Type locality.—Philadelphia, Pennsylvania.

Distribution.—Probably occurs rarely over most of Oklahoma but recorded only from the northeastern part of the Mixed-grass Plains biotic district.

Records.—Noble Co., Ceres (CM); Payne Co., Stillwater, (OAMC).

Remarks.—This tree bat generally is rare wherever it occurs. The specimens recorded from Oklahoma possibly were migrants. However, the author has been informed by C. W. Hibbard that the species breeds in eastern Kansas. Therefore, it is quite possible that it also breeds in Oklahoma. The species has not previously been recorded from the state.

Nycticeius humeralis (Rafinesque).—EVENING-BAT.

1818. *Vespertilio humeralis* Rafinesque, American Monthly Magazine **3**:445 (*fide* Miller, 1924: 80).

Type locality.—Kentucky.

Distribution.—Forests of eastern Oklahoma. Recorded from the Mississippi and Ouachita biotic districts and from the eastern extension of the Osage Savanna district.

Records.—McCurtain Co., Glover (UM), 2 miles west of Smithville (OU); Pushmataha Co., 4 miles northeast of Tuskahoma (Ortenburger, 1926: 122); Sequoyah Co., Redland (Miller, 1897: 120).

Remarks.—This forest bat is one of the most characteristic species of the Mississippi and Ouachita districts.

Corynorhinus rafinesquii rafinesquii (Lesson).—LONG-EARED BAT.

1827. *Plecotus rafinesquii* Lesson, Man. de Mamm.: 96.

Type locality.—"The lower parts of the Ohio" River.

Distribution.—Southwestern Oklahoma. Recorded only from the Ouachita biotic district.

Records.—LeFlore Co., Houston (OU); McCurtain Co., 2 miles west of Smithville (OU).

Remarks.—The eastern long-eared bat, race *rafinesquii*, supposedly intergrades with the western long-eared bat, race *pallescens*. However, no specimens of the eastern bat have been taken west of the Ouachita biotic district, and no specimens of the western race have been recorded from east of the Mixed-grass Plains district. Likewise, the specimens or *rafinesquii* show no approach to *pallescens*, and the specimens of *pallescens* show no intergradation with *rafinesquii*. The race *rafinesquii* has not previously been recorded from Oklahoma.

Corynorhinus rafinesquii pallescens Miller.—LONG-EARED BAT.

1897. *Corynorhinus macrotis pallescens* Miller, North Amer. Fauna **13**:52.

Type locality.—Keam Canyon, Navajo County, Arizona.

Distribution.—Probably all of Oklahoma west of the Osage Savanna district, but recorded only from the Mixed-grass Plains district.

Records.—Blaine Co., 3 miles southeast of Southard and Salt Creek Canyon (KU); Woods Co., 2 miles west of Edith and 6 miles northeast of Freedom (Jackson and

Warfel, 1933: 67), Marehew Cave, one-half mile south of Oklahoma—Kansas line (KU); Woodward Co., 10 miles south of Freedom (UM), Freedom (OU).

Remarks.—This western cave bat may be expected to occur where there are caves in the gypsum outcrops in the western part of the Mixed-grass Plains district and probably in the Short-grass Plains district.

Antrozous pallidus (LeConte).—PALLID BAT.

1856. *V[espertilio] pallidus* LeConte, Proc. Acad. Nat. Sci. Philadelphia **7** (1854-5):437.

Type locality.—El Paso, El Paso County, Texas (see Miller, 1897: 44).

Distribution.—Western tip of Oklahoma Panhandle. Recorded only from the Mesa de Maya biotic district.

Records.—Cimarron Co., 3 miles north of Kenton (UM).

Remarks.—This cave bat probably occurs also in gypsum caves in the Short-grass Plains district. At the locality at which the one specimen was taken in the Mesa de Maya district, the pallid bat was abundant in the evenings, flying over the slopes and ravines of the mesa.

Tadarida mexicana (Saussure).—FREETAIL BAT.

1860. *Molossus mexicanus* Saussure, Revue et magasin de zoologie, sèr. 2, **12**:283 (*fide* Miller, 1924: 86).

Type locality.—Ameca, Jalisco, Mexico.

Distribution.—Probably all of Oklahoma west of the Osage Savanna district, but recorded only from the Mixed-grass Plains district.

Records.—Cleveland Co., Norman (Ortenburger, 1926: 122); Major Co., Graver Creek, 9 miles southwest of Togo (UM and KU), Sherman (TU); Payne Co., Stillwater (OAMC); Woods Co., 2 miles west of Edith (OU), Marehew Cave, near Oklahoma—Kansas line (KU).

Remarks.—This southwestern, cave bat generally occurs in large numbers wherever it is found. It is by far the commonest bat of western Oklahoma, where huge colonies often are found in gypsum caves in the western part of the Mixed-grass Plains district. The few specimens recorded from the eastern part of the district are said to have been taken in buildings, where individuals of this species also often occur.

Euarctos americanus americanus (Pallas).—BLACK BEAR.

1780. *Ursus americanus* Pallas, Spicilegia zoologica, fasc. 14: 5 (*fide* Miller, 1924: 90).

Type locality.—Eastern North America.

Distribution.—Reported to have been abundant at one time over most of Oklahoma.

Records.—Comanche Co., Wichita Mountains (Bailey, 1905: 186); "Cross Timbers" (Osage Savanna district) (Thwaites, 1905: 275); "Throughout the [Red River] valley" (Marcy, 1854: 200).

Remarks.—The accounts of early travelers indicate that the black bear was one of the common carnivores of Oklahoma, but the species is rare or

extirpated there today. According to Foreman (1926: 83), in 1824 a single shipment of 460 bear skins was made from the Chouteau trading post at the mouth of the Verdigris River.

Procyon lotor hirtus Nelson and Goldman.—RACCOON.

1930. *Procyon lotor hirtus* Nelson and Goldman, Journ. of Mammalogy **11**:455.

Type locality.—Elk River, Sherburne County, Minnesota.

Distribution.—Probably most of main part of Oklahoma. Recorded from the Ozark, Cherokee Prairie, Mixed-grass Plains, and Wichita Mountain biotic districts.

Records.—Adair Co., Stilwell *(MCZ)*; Comanche Co., Wichita National Forest *(KU)*; Payne Co., Stillwater Creek near Stillwater (OAMC); Tulsa Co., Mohawk Park (Blair, 1938: 496); Woods Co., 15 miles east of Edith (Jackson and Warfel, 1933: 67).

Remarks.—The raccoon probably occurs along streams throughout the state. The specimens available, however, are not adequate for determining what races occur in the state, and they all have been assigned to the race *hirtus*. It is possible that specimens, if available, from the Mississippi and Short-grass Plains districts, would be referable to other subspecies.

Mustela frenata primulina Jackson.—WEASEL.

1913. *Mustela primulina* Jackson, Proc. Biol. Soc. Washington **26**:123.

Type locality.—Five miles northeast of Avilla, Jasper County, Missouri.

Distribution.—Probably the eastern two-thirds of the main part of Oklahoma, but recorded only from the Mixed-grass Plains district.

Records.—Cleveland Co., Norman (E. R. Hall, unpublished manuscript); Payne Co., 8 miles northwest of Stillwater (OAMC).

Remarks.—Weasels are scarce in Oklahoma, but they probably will be found to occur in all of the biotic districts of the state. This richly colored race probably intergrades in the Mixed-grass Plains district with the race *neomexicanus*, which occurs in western Texas and Kansas, but has not yet been recorded from western Oklahoma.

In referring the race *primulina* to the species *frenata*, the author follows Hall (1936: 104).

Mustela vison mink Peale and Beauvois.—MINK.

1796. *Mustela mink* Peale and Beauvois, Catal. Peale's Mus., Philadelphia: 39 (*fide* Miller, 1924: 125).

Type locality.—Maryland.

Distribution.—Probably the forests of eastern Oklahoma. Recorded from the Ozark, Cherokee Prairie, and Osage Savanna biotic districts.

Records.—Cherokee Co., Scraper (WFB); Pittsburgh Co. *(KU)*; Tulsa Co., Mohawk Park (Blair, 1938: 496); Wagoner Co., Adams Creek, 5 miles east of Broken Arrow *(idem)*.

Remarks.—The mink is an inhabitant of wooded stream valleys, and in these it extends for an unknown distance westward across Oklahoma. Specimens from central Oklahoma, however, are assigned to the race *letifera*.

Mustela vison letifera Hollister.—MINK.

1913. *Mustela vison letifera* Hollister, Proc. U. S. Nat. Mus. **44**:475.

Type locality.—Elk River, Sherburne County, Minnesota.

Distribution.—North-central Oklahoma. Recorded only from the Mixed-grass Plains district.

Records.—Cleveland Co., 2 miles south of Norman (OU); Payne Co., Stillwater Creek, near Stillwater (OAMC).

Remarks.—The races, *letifera* and *mink*, probably intergrade in the Osage Savanna district, but no material is available, as yet, to demonstrate this.

Lutra canadensis lataxina F. Cuvier.—OTTER.

1823. *Lutra lataxina* F. Cuvier, Dict. des Sci. Nat. **27**:242 (*fide* Miller, 1924:129).

Type locality.—South Carolina.

Distribution.—Probably occurred at one time over most of Oklahoma. Recorded only from the Short-grass Plains biotic district, and reported to occur in the Ozark district.

Records.—Woodward Co. *(KU)*; "Throughout the [Red River] valley" (Marcy, 1854: 200).

Remarks.—The otter undoubtedly was once common along the streams throughout the state. Today it is rare in Oklahoma. Otter are reported by local residents to have been seen in recent years on Spavinaw Creek in Delaware County and on Spring Creek in Mayes County.

No specimens of the otter from Oklahoma have been examined, so the identification of the specimen in the University of Kansas Museum is followed. It is quite possible, however, that the otter of western Oklahoma should be referred to the race *interior* rather than to *lataxina*.

Spilogale interrupta (Rafinesque).—PRAIRIE SPOTTED-SKUNK.

1820. *Mephitis interrupta* Rafinesque, Annals of Nature **1**:3.

Type locality.—"Upper Missouri" River.

Distribution.—Probably most of Oklahoma. Recorded from the Mixed-grass Plains, Wichita Mountain, Osage Savanna, and Cherokee Prairie biotic districts.

Records.—Alfalfa Co., 9 miles east and 3 miles north of Cherokee (Jackson and Warfel, 1933: 68); Cleveland Co., Norman *(KU)*; Comanche Co., Mount Scott, Wichita Mountains (Howell, 1906: 19); Noble Co., Black Bear Creek, 14 miles north of Stillwater (OAMC); Pottawatomie Co., northwest of Tecumseh *(KU)*; *Tulsa* Co., Mohawk Park and Tulsa (Blair, 1938: 497); Woods Co., Alva (Howell, 1906: 19).

Remarks.—The spotted-skunk is very tolerant of habitats, and wherever it is found it generally occupies both forest and grassland habitats.

Mephitis mephitis mesomelas Lichtenstein.—EASTERN SKUNK.

1832. *Mephitis mesomelas* Lichtenstein, Darstellung neur oder wenig bekannter Säugethiere, pl. 45, fig. 2, with accompanying text (*fide* Miller, 1924: 137).

Type locality.—Louisiana.

Distribution.—Approximately the eastern half of the main part of Oklahoma. Recorded from the Mississippi, Ouachita, Ozark, Cherokee Prairie, Osage Savanna, and Mixed-grass Plains biotic districts.

Records.—Caddo Co., Fort Cobb (Howell, 1901: 30); Creek Co., 1 mile north of Kiefer (WFB); Dewey Co. *(KU);* LeFlore Co., 6 miles west of Heavener (OU); Mayes Co., 3 miles west of Locust Grove (WFB); McCurtain Co., 15 miles southeast of Broken Bow (OU); Payne Co., 2 miles west of Stillwater (OAMC); Rogers Co., Garnett (Blair, 1938: 497); Tulsa Co., Tulsa *(idem).*

Remarks.—The race *mesomelas* is replaced in western Oklahoma by *varians,* and specimens from the Mixed-grass Plains district are intermediate in character between the two races.

In assigning the race *mesomelas* to the species *mephitis,* the author follows Hall (1936:66).

Mephitis mephitis varians Gray.—EASTERN SKUNK.

1837. *Mephitis varians* Gray, Charlesworth's Mag. Nat. Hist. 1:581.

Type locality.—Texas.

Distribution.—Most of Oklahoma west of the Osage Savanna biotic district. Recorded from the Wichita Mountain, Short-grass Plains, and Mixed-grass Plains districts.

Records.—Comanche Co. *(KU),* Wichita National Forest (OU); Texas Co., 2 miles southwest of Optima (WFB); Woods Co., Alva (Elliot, 1907: 434), 2 miles west of Edith (Jackson and Warfel, 1933: 68); Beaver Co. (=Panhandle), Beaver (=North Canadian) River (Howell, 1901: 32); "Neutral Strip (=northwestern part of main section of state), Beaver (=North Canadian) River" (AM).

Remarks.—This long-tailed southwestern race of the striped skunk is a characteristic inhabitant of the Short-grass Plains district and intergrades eastward with *mesomelas.*

In assigning the race *varians* to the species *mephitis,* the author follows Hall (1936: 66).

Taxidea taxus berlandieri Baird.—BADGER.

1857. *Taxidea berlandieri* Baird, Mamm. N. Amer.: 205.

Type locality.—Llano Estacado, Texas, near border of New Mexico (see Hall, 1936: 78).

Distribution.—Probably most of Oklahoma west of the Osage Savanna biotic district. Recorded from the Mixed-grass Plains and Short-grass Plains districts.

Records.—Woods Co., Alva (*MCZ* and Elliot, 1907); Texas Co. *(KU);* "Neutral Strip" (=northwestern part of main section of state) *(AM).*

Remarks.—The badger, although widely distributed in western Oklahoma, is represented in collections few specimens. No records of the badger are

available from the Osage Savanna and Cherokee Prairie biotic districts, but if the animal does occur there it probably is referable to the race *taxus*, which ranges northeastward through the tall-grass prairies.

Vulpes fulva (Desmarest).—RED FOX.

1820. *Canis fulvus* Desmarest, Mammalogie **1**:203.

Type locality.—Virginia.

Distribution.—Eastern Oklahoma. Specimens recorded only from the Ozark biotic district.

Records.—Cherokee Co., 12 miles north of Tahlequah (UM); Red River Valley (Marcy, 1854: 200).

Remarks.—The red fox is said by local residents to be common in the Ozark biotic district.

Vulpes velox velox (Say).—KIT FOX.

1823. [*Canis*] *velox* Say, Long's Exped. to Rocky Mts. **1**:487 (*fide* Miller, 1924: 146).

Type locality.—South Platte River, Colorado.

Distribution.—Probably Oklahoma Panhandle and extreme western part of main section of state. Recorded only from the Mixed-grass Plains biotic district.

Records.—"Neutral Strip" (=northwestern part of main section of state) *(KU)*.

Remarks.—The kit fox is one of the most characteristic mammals of the Short-grass Plains district, and, while it has not been taken in that district in Oklahoma, it has been recorded from the Short-grass plains district to the north and to the south of Oklahoma.

Urocyon cinereoargenteus ocythous Bangs.—GRAY FOX.

1899. *Urocyon cinereoargenteus ocythous* Bangs, Proc. New England Zool. Club **1**:43.

Type locality.—Platteville, Grant County, Wisconsin.

Distribution.—Probably forests of eastern Oklahoma, but recorded only from the Ozark biotic district.

Record.—Adair Co. *(KU)*.

Remarks.—The distribution of the gray fox in Oklahoma is imperfectly known, but it probably occurs in other biotic districts of eastern Oklahoma.

Canis latrans nebrascensis Merriam.—COYOTE.

1897. *Canis pallidus* Merriam, Proc. Biol. Soc. Washington **11**:24. (not of Rüppell, 1826.)

1898. *Canis nebrascensis* Merriam, Science, n. s., **8**:782. (Substitute for *pallidus* Merriam.)

Type locality.—Johnstown, Brown County, Nebraska.

Distribution.—Probably all of Oklahoma west of the Osage Savanna biotic district except the area from the Wichita Mountains southward. Rec-

orded from the Mixed-grass Plains and Short-grass Plains districts.

Records.—Payne Co., 6 miles north, 2 miles west of Stillwater (OAMC); Woods Co., 2 miles west of Edith (Jackson and Warfel, 1933: 68); Woodward Co. *(KU)*; "No Man's Land" (=Panhandle) *(KU)*.

Remarks.—The coyote ranges chiefly over western Oklahoma but extends eastward in grassland habitats. No specimens are available from eastern Oklahoma, and the coyote of the Cherokee Prairie and Osage Savanna biotic districts possibly is of the race *latrans*, which ranges northeastward in the tall-grass prairies. Coyotes have been recorded (Oklahoma Game and Fish Commission, 1936: 44) from Alfalfa, Caddo, Comanche, Ellis, Grady, Major, Okmulgee, Osage, Stephens, and Washington counties, but these animals could be assigned to races only on a geographic basis since there are no recorded specimens to substantiate them.

In assigning the race *texensis* to the species *latrans*, the author follows Nelson (1932: 223).

Canis latrans texensis Bailey.—COYOTE.

1897. *Canis frustror* Merriam, Proc. Biol. Soc. Washington **11**:26 (not of Woodhouse, 1852.)

1905. *Canis nebrascensis texensis* Bailey, North Amer. Fauna **25**:175.

Type locality.—Forty-five miles southwest of Corpus Christi, Nueces County, Texas.

Distribution.—Recorded only from the Wichita Mountain district.

Record.—Comanche Co. *(KU)*.

Remarks.—The area of intergradation of *texensis* with the race *nebrascensis* is not known, but it is probable that all of coyotes of southwestern Oklahoma are referable to *texensis*.

In assigning the race texensis to the species *latrans*, the author follows Nelson (1932: 224).

Canis rufus rufus Audubon and Bachman.—RED WOLF.

1851. *Canis lupus* var. *rufus* Audubon and Bachman, Quadr. N. Amer. **2**:240.

1852. *Canis frustror* Woodhouse, Proc. Acad. Nat. Sci., Philadelphia, **5**:147 (about 100 miles west of Fort Gibson, probably Payne County, Oklahoma.)

Type locality.—Fifteen miles west of Austin, Texas. (see Goldman, 1937: 38.)

Distribution.—Probably most of the main part of Oklahoma, but recorded only from the Osage Savanna and Mixed-grass Plains biotic districts.

Records.—Muskogee Co., Fort Gibson, Woodhouse (1852: 147); Tulsa Co., Red Fork (Bailey, 1905: 175); "Neutral Strip" (=northwestern part of main section of state) *(AM)*; "Beaver (=North Canadian) River" *(AM)*; "Beaver Creek" (probably North Canadian River), *(AM)*.

Remarks.—The wolf, *Canis frustror* Woodhouse, is considered by Goldman (1937: 45) to be a synonym of *Canis rufus rufus* Audubon and Bachman. The race *Canis rufus gregoryi* is said by Goldman (*op. cit.* :44) to range into southeastern Oklahoma. However, Goldman listed no specimens, so this race cannot yet be included in the state list.

Canis lupus nubilis Say.—GRAY WOLF.

1823. *Canis nubilus* Say, Long's Exped. to Rocky Mountains **1**:169 (*fide* Miller, 1924: 154).

Type locality.—Engineer Cantonment, near present town of Blair, Washington County, Nebraska.

Distribution.—Probably occurred at one time over most of Oklahoma. Recorded from the Short-grass Plains, Mixed-grass Plains and Wichita Mountain biotic districts.

Records.—Comanche Co., Wichita Mountains (Goldman, 1937: 42); "Neutral Strip" (=northwestern part of main section of state) *(AM)*; "No Man's Land" (=Panhandle) *(KU)*.

Remarks.—The gray wolf probably occurred at one time over most of the state. Wolves have been recorded from 24 counties in Oklahoma by the Oklahoma Game and Fish Commission (1936: 44), but no distinction is made between the red and gray wolf. The counties are: Adair, Atoka, Bryan, Carter, Coal, Garvin, Grady, Hughes, Jefferson, Johnston, Latimer, LeFlore, Love, Marshall, McClain, McCurtain, McIntosh, Murray, Okmulgee, Pittsburg, Pontotoc, Pottawatomie, Pushmataha, and Stephens.

In assigning the race *nubilus* to the species *lupus*, the author follows Goldman (1937: 45).

Felis concolor subspecies.—COUGAR.

Distribution.—Probably ranged at one time over most of Oklahoma. Supposed to be nearly extirpated there now.

Records.—Grant Co. (Snider, 1917: 185); Red River Valley (Marcy, 1854: 200).

Remarks.—The race or races of the cougar that inhabited Oklahoma are not known.

Lynx rufus baileyi Merriam.—BOB-CAT.

1890. *Lynx baileyi* Merriam, North Amer. Fauna **3**:79.

Type locality.—Moccasin Spring, Coconino County, Arizona.

Distribution.—Probably most of Oklahoma west of the Osage Savanna biotic district, but recorded only from the Mixed-grass Plains district.

Records.—"Beaver Creek" (probably North Canadian River) *(KU)*; "Neutral Strip" (=northwestern part of main section of state) (AM and *KU*); Red River Valley (Marcy, 1854: 200).

Remarks.—The bob-cat of western Oklahoma is referable to the race *baileyi*. No specimens are available from eastern Oklahoma, but it is probable that the bob-cat of that region should be referred to the race *rufus*. The Oklahoma Game and Fish Commission (1936: 44) recorded bob-cats from Atoka, Carter, Latimer, LeFlore, McCurtain, Murray, Osage, Pittsburg, and Pushmataha counties. It seems likely that the animals from these counties are referable to the eastern race *rufus*.

Marmota monax monax (Linnaeus).—WOODCHUCK.

1758. [*Mus*] *monax* Linnaeus, Syst. Nat., ed. 10, **1**:60.

Type locality.—Maryland (see Howell, 1915: 22).

Distribution.—Northeastern Oklahoma. Recorded from the Ozark biotic district, but possibly occurs also in the Ouachita district.

Records.—Cherokee Co., Scraper (WFB); Mayes Co., Locust Grove (WFB).

Remarks.—This species, although quite abundant in the Ozark district, is not represented by specimens in any of the collections that have been examined from Oklahoma. It reaches its western limit at the western border of the Ozark district, and possibly reaches its southern limit at the southern border of the district.

Citellus variegatus grammurus (Say).—ROCK SQUIRREL.

1823. *S[ciurus] grammurus* Say, Long's Exped. to Rocky Mountains **2**:72 (*fide* Miller, 1924: 180).

Type locality.—Purgatory River, near mouth of Chacuaco Creek, Las Animas County, Colorado.

Distribution.—Rocky ravines in the Oklahoma Panhandle as far east as Beaver County. Recorded from the Short-grass Plains and Mesa de Meya biotic districts.

Records.—Beaver Co. (OAMC); Cimarron Co., Black Mesa (TU).

Remarks.—This saxicolous species apparently ranges into the Oklahoma Panhandle from the Rocky Mountains by way of rocky outcrops along the Cimarron and North Canadian rivers.

In assigning the race *grammurus* to the species *variegatus*, the author follows Howell (1938: 142).

Citellus spilosoma major (Merriam).—SPOTTED SPERMOPHILE.

1890. *Spermophilus spilosoma major* Merriam, North Amer. Fauna **4**:39.

Type localiity.—Albuquerque, Bernalillo County, New Mexico.

Distribution.—Western part of main section of Oklahoma and probably most of the Panhandle. Recorded from the Mixed-grass Plains and Short-grass Plains biotic districts.

Records.—Dewey Co., 5 miles southwest of Canton (KU); Woodward Co., Woodward (Howell, 1938: 128).

Remarks.—This typical short-grass plains species apparently reaches its eastern limit in the western part of the Mixed-grass Plains biotic district.

Citellus tridecemlineatus texensis (Merriam).—THIRTEEN-LINED SPERMOPHILE.

1898. *Spermophilus tridecemlineatus texensis* Merriam, Proc. Biol. Soc. Washington **12**:71.

Type locality.—Gainesville, Cooke County, Texas.

Distribution.—Grasslands of central Oklahoma. Recorded from the Mixed-grass Plains, Osage Savanna, Cherokee Prairie, and Wichita Mountain biotic districts.

Records.—Caddo Co., Apache (Howell, 1938: 111); Canadian Co., 2 miles northwest of El Reno (OU), Fort Reno (Howell, 1938: 111); Cleveland Co., Noble

(AM and Elliot, 1907: 168), Norman (KU and OU); Comanche Co., Lawton and Mount Scott P. O. (Howell, 1938: 111); Dewey Co., 5 miles southwest of Canton (KU); Logan Co., Orlando (Howell, 1938: 111); Muskogee Co., 3 miles east of Wainwright (OU); Noble Co., Billings (OAMC); Arnettville (Elliot, 1907: 168); Osage Co., 5 miles north of Sand Springs (UM); Payne Co., Stillwater (OAMC); Rogers Co., Garnett (Blair, 1938: 498); Tulsa Co., Mohawk Park *(idem)*.

Remarks.—This species occupies grassland habitats wherever it occurs in Oklahoma. The pronounced reddish color of the race *texensis* apparently is correlated with the reddish color of the Permian red soils of the Mixed-grass Plains biotic district. The specimen examined from El Reno shows an approach to *arenicola* in its pale coloration.

Citellus tridecemlineatus arenicola Howell.—THIRTEEN-LINED SPERMOPHILE.

1928. *Citellus tridecemlineatus arenicola* Howell, Proc. Biol. Soc. Washington **41**:213.

Type locality.—Pendennis, Lane County, Kansas.

Distribution.—Oklahoma Panhandle and northwestern part of main section of state. Recorded from the Short-grass Plains biotic district, and from the northwestern part of the Mixed-grass Plains district.

Records.—Alfalfa Co., 3 miles east of Cherokee (OU); Major Co., 3 miles west of Orienta (OU); Texas Co., 2 miles east of Eva (KU), Hooker (LSU); Woods Co., Alva and White Horse Spring (Elliot, 1907: 168); Woodward Co., Woodward (Howell, 1938: 112); "Neutral Strip" (=northwestern part of main section of state) (AM).

Remarks.—The pale colors of the race *arenicola* apparently are correlated with the pale color of the soil on which it lives. The race *arenicola* intergrades with *texensis* in the western part of the Mixed-grass Plains biotic district.

Cynomys ludovicianus ludovicianus (Ord).—PRAIRIE DOG.

1815. *Arctomys ludoviciana* Ord, Guthrie's Geography, 2d Amer. ed., **2**:292 (*fide* Miller, 1924: 196).

1905. *Cynomys pyrrotrichus* Elliot, Proc. Biol. Soc. Washington **18**:139 (White Horse Spring, Woods County, Oklahoma).

Type locality.—Upper Missouri River.

Distribution.—Probably all of Oklahoma west of the Osage Savanna biotic district. Recorded from the Short-grass Plains, Mixed-grass Plains, Mesa de Maya, and Wichita Mountain biotic districts. Said by local residents to occur in the Mesquite Plains district. Possibly existed at one time in the Osage Savanna district.

Records.—Alfalfa Co., Cherokee (OU); 5 miles south of Cherokee *(KU)*; Cimarron Co., Kenton (GHL); Comanche Co., Chattanooga and Mount Scott P. O. (Hollister, 1916: 18), Wichita National Forest (OU); Dewey Co. *(KU)*; Harper Co., Laverne (LSU); Kay Co., Ponca Agency (Hollister, 1916: 18); Major Co., Orienta (OU); Noble Co., Otoe Indian Reservation (OAMC); Payne Co., 1 mile north, 7 miles west of Stillwater (GAM); Woods Co., 3 miles west of Edith (Jackson and Warfel, 1933: 68), Alva, *(KU)*, White Horse Spring (Hollister, 1916: 18), 3 miles east of Waynoka (TU); "Beaver Co." (=Panhandle) (*KU* and Hollister, 1916: 18); "Neutral Strip" (=northwestern part of main section of state) *(idem)*.

Remarks.—In Oklahoma, this interesting species has held its own surpris-

ingly well in spite of relentless persecution by poisoners, who apparently begrudge it the little space it occupies and the grasshoppers it eats.

Euatamias quadrivittatus quadrivittatus (Say).—WESTERN CHIPMUNK.

1823. *Sciurus quadrivittatus* Say, Long's Exped. to Rocky Mountains **2**:45 (*fide* Miller, 1924: 203).

Type locality.—On the Arkansas River, about 26 miles below Canyon City, in Pueblo County, Colorado.

Distribution.—Northwestern corner of Oklahoma Panhandle. Recorded from Mesa de Maya biotic district.

Records.—Cimarron Co., Kenton (Howell, 1929: 83) Black Mesa (TU).

Remarks.—This southern Rocky Mountain form extends into the extreme northwestern corner of the Panhandle in the rocky ravines and mesa slopes of the Mesa de Maya. Several individuals were seen on talus slopes about 3 miles north of Kenton in August, 1937.

Tamias striatus venustus Bangs.—EASTERN CHIPMUNK.

1896. *Tamias striatus venustus* Bangs, Proc. Biol. Soc. Washington **10**:137.

Type locality.—Stilwell, Adair County, Oklahoma.

Distribution.—Eastern Oklahoma except southwestern corner. Recorded from the Ozark, Ouachita, and Osgood Savanna biotic districts.

Records.—Adair Co., Stillwell (Howell, 1929: 23); Cherokee Co., Scraper (UM); Le Flore Co., Kiamichi Creek, Zoe, and 5 miles northwest of Stapp (OU); Mayes Co., 5 miles south of Locust Grove (WFB); McCurtain Co., 5 miles west of Smithville (OU); Tulsa Co., Red Fork (Howell, 1929: 23).

Remarks.—The eastern chipmunk is one of the most characteristic mammals of the Ozark district, where it is most frequently encountered on rocky hillslopes and in mesic ravines. The two specimens recorded by Howell from Red Fork extend the range of the species into the Osage Savanna district. However, in several years of field work in that area the author has failed to find the species, and has heard of only one individual having been seen. Therefore, it seems likely that it is extremely rare west of the Ozark district.

Sciurus carolinensis carolinensis Gmelin.—GRAY SQUIRREL.

1788. [*Sciurus*] *carolinensis* Gmelin, Syst. Nat. **1**:148.

Type locality.—"Carolina."

Distribution.—Eastern Oklahoma, west to western edge of the Osage Savanna biotic district. Recorded from the Mississippi, Ozark, Cherokee Prairie, and Osage Savanna biotic districts, but undoubtedly occurs also in the Ouachita district.

Records.—Cherokee Co., Scraper (TU); Mayes Co., Locust Grove (TU); McCurtain Co., 15 miles southeast of Broken Bow (OU); Muskogee Co., 3 miles southeast of Wainwright (OU); Rogers Co., Garnett (Blair, 1938: 498); Tulsa Co., Mohawk Park (*idem*).

Remarks.—The gray squirrel is abundant in flood-plain forests of the biotic

districts of eastern Oklahoma. It apparently does not extend westward beyond the Osage Savanna district.

Sciurus niger rufiventer Geoffroy.—FOX-SQUIRREL.

1803. *Sciurus rufiventer* Geoffroy, Catal. Mamm. Mus. Nat. Hist. Nat., Paris: 176 (*fide* Miller, 1924: 226).

Type locality.—Mississippi Valley, exact locality not known.

Distribution.—Most of the main part of Oklahoma. Recorded from the Mississippi, Ouachita, Ozark, Cherokee Prairie, Osage Savanna, Mixed-grass Plains, and Wichita Mountain biotic dstricts.

Records.—Adair Co. *(KU);* Alfalfa Co., Salt Fork River, near Cherokee (Jackson and Warfel, 1933: 69); Canadian Co., Yukon *(KU);* Cherokee Co., Scraper (UM); Cleveland Co., Noble (FM), 2 miles south of Norman (OU); Comanche Co., Roosevelt (LSU), Wichita National Forest (OU); Creek Co. (KU); Dewey Co. *(KU);* Garfield Co. (KU); LeFlore Co., 1 mile northeast of Zoe (OU); Major Co., 9 miles southwest of Togo (UM), Cleo Springs (Jackson and Warfel, 1933: 69); Mayes Co., Locust Grove (TU); McCurtain Co., 2 miles north of Broken Bow and 10 miles southeast of Broken Bow (OU); Muskogee Co., 3 miles east of Wainwright (OU); Payne Co., Stillwater (OAMC); Pottawatomie Co., 7 miles southeast of Tecumseh *(KU);* Roger Mills Co., 3 miles west of Cheyenne (CM); Rogers Co., Garnett (Blair, 1938: 499); Tulsa Co., Mohawk Park *(idem);* Woods Co., Waynoka (TU), 3 miles southwest of Waynoka (OU).

Remarks.—The fox-squirrel is widely distributed in the upland forests of the biotic district of eastern Oklahoma, and extends westward along wooded stream valleys nearly across the Mixed-grass Plains district.

Glaucomys volans saturatus Howell.—FLYING SQUIRREL.

1915. *Glaucomys volans saturatus* Howell, Proc. Biol. Soc. Washington **28**:110.

Type locality.—Dothan, Alabama.

Distribution.—Approximately the eastern half of the main part of Oklahoma. Recorded from the Ozark, Cherokee Prairie, and eastern part of the Mixed-grass Plains biotic districts, but undoubtedly occurs in the Mississippi, Ouachita, and Osage Savanna districts.

Records.—Adair Co., Stilwell (Howell, 1918: 23); Cherokee Co., Scraper (UM); Creek Co., Sapulpa (KU); Oklahoma Co., Oklahoma City (Howell, 1918: 23); Payne Co., Stillwater (OAMC); Rogers Co., Twin Lakes (HDC); Tulsa Co., Mohawk Park (Blair, 1938: 499), Red Fork (Howell, 1918: 26).

Remarks.—The material examined indicates that there is no justifiable basis for the recognition of both the subspecies *volans* and *saturatus* in Oklahoma, as was done by Howell (1918). The Oklahoma specimens are closer to *saturatus* than to *volans* and should be assigned to that subspecies.

West of the Ozark district, the flying squirrel is confined to wooded stream valleys, and it is in these that it extends into the eastern edge of the Mixed-grass Plains district.

Geomys breviceps breviceps Baird.—POCKET-GOPHER.

1855. *Geomys breviceps* Baird, Proc. Acad. Nat. Sci. Philadelphia **7**:335.

Type locality.—Prairie Mer Rouge, Morehouse Parish, Louisiana.

Distribution.—Approximately the eastern half of the main part of Oklahoma. Recorded from the Mississippi, Cherokee Prairie, and Osage Savanna biotic districts.

Records.—Choctaw Co., near mouth of Boggy River (=creek) (Merriam, 1895: 132); McCurtain Co., 13 miles southwest of Broken Bow (OU); Muskogee Co., Fort Gibson (Merriam, 1895: 132), 3 miles east of Wainwright (OU); Rogers Co., Garnett (Blair, 1938: 499); Tulsa Co., Mohawk Park *(idem)*.

Remarks.—This pocket-gopher often occurs in alluvial soil, and its distribution generally follows the stream systems. However, in the Cherokee Prairie and Osage Savanna districts it is more abundant in upland grassland associations than in the stream valleys.

Geomys breviceps llanensis Bailey.—POCKET-GOPHER.

1905. *Geomys breviceps llanensis* Bailey, North Amer. Fauna **25**: 129.

Type locality.—Llano, Llano County, Texas.

Distribution.—Approximately the western half of the main part of Oklahoma. Recorded from the Mixed-grass Plains and Mesquite Plains biotic districts and from the western edge of the Osage Savanna district. Possibly ranges westward into the Short-grass Plains district.

Records.—Alfalfa Co., 2 miles south and 2 miles east of Cherokee (OU); Cleveland Co., Norman (KU and OU); Cotton Co., 12 miles south of Temple (UM); Dewey Co., 5 miles southwest of Canton (KU); Harmon Co., Buck Creek, extreme southwestern corner of state (UM); Jackson Co., 14 miles south of Olustee (UM); Kay Co., Ponca Agency (Merriam, 1895: 132); Major Co., Cimarron River near Cleo Springs (Jackson and Warfel, 1933:69); Oklahoma Co., Oklahoma City (Merriam, 1895, 132); Payne Co., Stillwater (OAMC); Pottawatomie Co., Tecumseh (KU and OAMC); Woods Co., Alva (Elliot, 1907: 310), Waynoka (TU), 5 miles south of Waynoka (UM).

Remarks.—The reddish color of the race *llanensis* apparently is correlated with the color of the Permian red soils on which it occurs. This race generally inhabits alluvial soil, and it is most often found in the moist soil near the stream edge. It occurs also in the sand dunes of the western part of the Mixed-grass Plains district.

Perognathus flavescens copei Rhoads.—POCKET-MOUSE.

1894. *Perognathus copei* Rhoads, Proc. Acad. Nat. Sci. Philadelphia (1893):404.

Type locality.—Near Mobeetie, Wheeler County, Texas.

Distribution.—Western part of main section of Oklahoma and the Panhandle. Recorded from the Mesa de Maya and Mixed-grass Plains biotic districts, but undoubtedly occurs also in the Short-grass Plains district.

Records.—Cimarron Co., 3 miles north of Kenton (UM); Dewey Co. (KU); Woods Co., 5 miles south of Waynoka (UM).

Remarks.—In Oklahoma this pocket-mouse reaches its eastern limit in the Mixed-grass Plains biotic district. In the Mesa de Maya district the species was found on rocky, brushy ravine slopes, where it was associated with the deer-mouse *(Peromyscus maniculatus osgoodi)* and the wood-mouse *(Peromyscus leucopus tornillo)*. In the Mixed-grass Plains district it was found on sand dunes.

Perognathus flavus flavus Baird.—SILKY POCKET-MOUSE.

1855. *Perognatus* [*sic*] *flavus* Baird, Proc. Acad. Nat. Sci. Philadelphia **7**:332.

Type locality.—El Paso, El Paso County, Texas.

Distribution.—Western part of the main section of Oklahoma and the Panhandle. Recorded from the Mesa de Maya, Mesquite Plains, Short-grass Plains, and Mixed-grass Plains biotic districts.

Records.—Cimarron Co., Kenton (CM), 3 miles north of Kenton (UM); Jackson Co., 14 miles south of Olustee (UM); Texas Co., 2 miles east of Eva (KU); Woods Co., Edith Plain (Jackson and Warfel, 1933: 69); "Beaver" (=North Canadian) River *(AM)*.

Remarks.—In Oklahoma, the silky pocket-mouse reaches its eastern limit in the Mixed-grass Plains biotic district.

Perognathus hispidus paradoxus Merriam.—PLAINS POCKET-MOUSE.

1889. *Perognathus paradoxus* Merriam, North Amer. Fauna **1**:24.

Type locality.—Banner, Trego County, Kansas.

Distribution.—Oklahoma Panhandle and extreme western part of main section of state. Recorded from the Short-grass Plains and Mesquite Plains biotic districts and from the western edge of the Mixed-grass Plains district. Possibly occurs also in the Wichita Mountain and Mesa de Maya districts.

Records.—Jackson Co., 14 miles south of Olustee (UM); Texas Co., 2 miles east of Eva (KU); Woods Co., Alva and White Horse Spring (FM), Edith Plain (Jackson and Warfel, 1933: 69).

Remarks.—The race *paradoxus* intergrades with *spilotus* in the western part of the Mixed-grass Plains biotic district.

Perognathus hispidus spilotus Merriam.—PLAINS POCKET-MOUSE.

1889. *Perognathus paradoxus spilotus* Merriam, North Amer. Fauna **1**:25.

1903. *Perognathus hispidus maximus* Elliot, Field Colub. Mus., publ. 87, zool. ser. **3**:253. (Noble, Cleveland County, Oklahoma.)

Type locality.—Gainesville, Cooke County, Texas.

Distribution.—Probably all of the main part of Oklahoma except the extreme western portion and the eastern forests. Recorded from the Mixed-grass Plains, Osage Savanna, and Cherokee Prairie biotic districts.

Records.—Cleveland Co., Noble (FM), 4 miles south of Norman (OU); Cotton Co., 12 miles south of Temple (UM); Noble Co., Arnettville (FM); Osage Co., 14 miles southeast of Fairfax (UM); Pawnee Co., opposite Turkey Island on the Arkansas River (OAMC); Rogers Co., Garnett (Blair, 1938: 500).

Remarks.—This dark race of the plains pocket-mouse is well marked in the Osage Savanna district and reaches its best development in the Cherokee Prairie district. It is not well marked at the type locality of either *spilotus* or *maximus*, and specimens from either place could be referred to *hispidus* without a great deal of difficulty. However, it seems best to utilize a name already proposed, whenever possible, even though it has been given to an intermediate form. Since *spilotus* has priority it must be used instead of *maximus*, which has been in general use for several years.

Dipodomys elator Merriam.—PLAINS KANGAROO RAT.

1894. *Dipodomys elator* Merriam, Proc. Biol. Soc. Washington **9**:109.

Type locality.—Henrietta, Clay County, Texas.

Distribution.—Known in Oklahoma only from the southern part of the Mixed-grass Plains biotic district.

Records.—Comanche Co., Chattanooga (Bailey, 1905: 148).

Remarks.—According to Bailey (1905: 148), this little known species lives in heavy soil and makes its burrows beneath the mesquite.

Dipodomys ordii richardsoni (Allen).—FIVE-TOED KANGAROO RAT.

1891. *Dipodops richardsoni* Allen, Bull. Amer. Mus. Nat. Hist. **3**:277.

Type locality.—"One of the sources of the Beaver [North Canadian] River in the extreme northwestern corner of the [Indian] territory, in the so-called Neutral Strip" (probably Harper County, Oklahoma).

Distribution.—Sand areas in probably all of Oklahoma west of the Osage Savanna biotic district. Recorded from the Mixed-grass Plains, Mesquite Plains, and Short-grass Plains biotic districts.

Records.—Alfalfa Co., 3 miles east of Cherokee (OU); Comarron Co., Kenton (CM); Cleveland Co., 2 miles southwest of Norman (OU); Cotton Co., 12 miles south of Temple (UM); Grant Co., 12 miles west of Lamont (WFB); Harper Co., 4 miles north of Laverne (UM); Jackson Co., 12 miles south of Olustee (UM); Major Co., 3 miles south of Cleo Springs (OU); Texas Co., 4 miles northeast of Eva (KU); Woods Co., Alva (Elliot, 1907: 330), 2 miles south of Edith and 3 miles southwest of Waynoka (OU), 5 miles south of Waynoka (UM), 3-5 miles south of Waynoka (TU); "Beaver (=North Canadian) River" (probably in Harper County) (*AM* and Elliot, 1907: 330).

Remarks.—This species inhabits the sand areas of western Oklahoma. In some years these kangaroo rats are extremely numerous. At such times this is the most abundant species in the sand areas.

The type locality of this race could not be in Beaver County, as listed by Miller (1924), since Allen stated in the original description that the type came from the Neutral Strip. At no time did the area known as the Neutral Strip include any part of the Panhandle, so it must be assumed that the specimen came from the northwestern corner of the main part of Oklahoma.

The 7 specimens examined from 2 miles southwest of Norman are paler and grayer in coloration than typical *richardsoni*, and apparently represent an undescribed local race of limited geographic extent.

Castor canadensis subspecies.—BEAVER.

Distribution.—Probably occurred at one time along streams throughout Oklahoma.

Records.—Ellis Co. (Snider, 1917: 188); Tulsa Co., 3 miles west of Wekiwa (WFB); "Above Cross Timbers" (west of Osage Savanna district) (Marcy, 1854: 200).

Remarks.—The beaver was once abundant along Oklahoma streams. Foreman (1926: 83) reported that, in one shipment in 1824, 387 beaver pelts were shipped from the Chouteau trading post at the mouth of the Verdigris. Today,

the beaver is nearly or totally extirpated in the state. Snider (1917: 188) reported that the last colony in the state was located on a small stream in Ellis County. In June, 1938, old beaver cuttings, but no fresh signs, were seen on the banks of the Arkansas River, about 3 miles west of Wekiwa, Tulsa County. Hugh Davis said that less than 2 years previous he saw fresh tracks and cuttings at this place.

The races of beaver that occurred in Oklahoma are not known. The beaver of western Oklahoma possibly would be referable to the race *texensis*, and the beaver of eastern Oklahoma to the race *carolinensis*.

Onychomys leucogaster arcticeps Rhoads.—GRASSHOPPER-MOUSE.

1898. *Onychomys arcticeps* Rhoads, Proc. Acad. Nat. Sci. Philadelphia: 194.

Type locality.—Clapham, Union County, New Mexico.

Distribution.—Oklahoma Panhandle. Recorded from both the Short-grass Plains and Mesa de Maya biotic districts.

Records.—Cimarron Co., Tesequite Canyon (TU); Texas Co., 2 miles east of Eva and 4 miles north of Eva (KU).

Remarks.—The race *arcticeps* intergrades with *breviauritus* at the approximate boundary between the Short-grass Plains and Mixed-grass Plains biotic districts.

Onychomys leucogaster breviauritus Hollister.—GRASSHOPPER-MOUSE.

1913. *Onychomys leucogaster breviauritus* Hollister, Proc. Biol. Soc. Washington **26**:216.

Type locality.—Fort Reno, Canadian County, Oklahoma.

Distribution.—Approximately the western half of the main part of Oklahoma. Recorded from the Mixed-grass Plains and Mesquite Plains biotic districts, but probably occurs also in the Wichita Mountain district.

Records.—Alfalfa Co., 3 miles east of Cherokee (OU); Canadian Co., Fort Reno (Hollister, 1923: 454); Dewey Co., 5 miles southwest of Canton (KU); Jackson Co., 14 miles south of Olustee (UM); Major Co., 3 miles south of Cleo Springs (OU); Woods Co., 2 miles west of Edith and 3 miles southwest of Waynoka (OU), 5 miles south of Waynoka (UM), Alva and White Horse Spring (Hollister, 1923: 454); Woodward Co., Camp Supply and Woodward (Hollister, 1923: 454); "Neutral Strip" (=northwestern part of main section of state) *(idem)*; "Beaver (=North Canadian) River" *(idem)*.

Remarks.—The grasshopper-mouse is one of several species of small mammals that reach their greatest abundance on the sand areas of the Mixed-grass Plains district.

Reithrodontomys montanus griseus Bailey.—GRAY HARVEST-MOUSE.

1905. *Reithrodontomys griseus* Bailey, North Amer. Fauna **25**:106.

Type locality.—San Antonio, Texas.

Distribution.—Probably all of Oklahoma except the eastern forest. Recorded from the Mixed-grass Plains, Short-grass Plains, Osage Savanna, and Cherokee Prairie biotic districts.

Records.—Alfalfa Co., 3 miles east of Cherokee (OU); Cimarron Co., 8 miles

east of Keyes (KU); Cleveland Co., 2 miles northeast of Noble (OU), Norman (OU and KU); Creek Co., Sapulpa (KU); Dewey Co., 5 miles southwest of Canton (KU); McClain Co., 10 miles southwest of Norman (OU); Muskogee Co., 3 miles east of Wainwright (OU); Rogers Co., Garnett (Blair, 1938: 501); Woods Co., Alva (Howell, 1914: 24 and AM), Edith (Jackson and Warfel, 1933: 70).

Remarks.—The specimen from Cimarron County is paler than typical *griseus* and possibly should be referred to the race *montanus*. It is not referable to *albescens* of western Nebraska and northwestern Kansas. The specimens from the Mixed-grass Plains district are more reddish in color than typical *griseus* but are referred to that race.

In the Cherokee Prairie district, the species is known only from xeric, limestone prairies that resemble in many respects the grasslands of the Osage Savanna and Mixed-grass Plains districts.

In assigning the race *griseus* to the species *montanus*, the author follows Benson (1935: 139).

Reithrodontomys fulvescens intermedius Allen.—GOLDEN HARVEST-MOUSE.

1895. *Reithrodontomys mexicanus intermedius* Allen, Bull. Amer. Mus. Nat. Hist. **7**:136.

Type locality.—Brownsville, Cameron County, Texas.

Distribution.—Known in Oklahoma only from the Wichita Mountain biotic district.

Records.—Comanche Co., Mount Scott, Wichita Mountains (Howell, 1914: 48).

Remarks.—Specimens of the golden harvest-mouse from the Wichita Mountains were assigned by Howell (1914: 48) to the race *intermedius*. This series has not been examined by the author, and the race *intermedius* is included in the state list on Howell's authority.

Reithrodontomys fulvescens aurantius Allen.—GOLDEN HARVEST-MOUSE.

1895. *Reithrodontomys mexicanus aurantius* Allen, Bull. Amer. Mus. Nat. Hist. **7**:137.

1899. *Reithrodontomys chysotis* Elliot, Field Columb. Mus., publ. 37, zool. ser., **1**:281. (Dougherty, Murray County, Oklahoma).

Type locality.—Lafayette, Lafayette Parish, Louisiana.

Distribution.—Eastern forest districts of Oklahoma. Recorded from the Mississippi, Ouachita, Ozark, and Osage Savanna biotic districts.

Records.—Adair Co., Stilwell (Howell, 1914: 49); Creek Co., Sapulpa (KU); Le Flore Co., 1 mile northeast of Zoe (OU); McCurtain Co., 2 miles west of Eagletown (UM), 2 miles west of Smithville (OU); Murray Co., Dougherty (Howell, 1914: 49); Muskogee Co., 3 miles east of Wainwright (OU); Pottawatomie Co., Tecumseh (KU).

Remarks.—The golden harvest-mouse is an inhabitant of lowland thickets in the biotic districts of eastern Oklahoma.

Peromyscus maniculatus osgoodi Mearns.—DEERMOUSE.

1890. *Hesperomys leucopus nebrascensis* Mearns, Bull. Amer. Mus. Nat Hist. **2**:285. Described on page 287. (Not *Hesperomys sonoriensis* var. *nebrascensis* Coues, 1877.)

1911. *Peromyscus maniculatus osgoodi* Mearns, Proc. Biol. Soc. Washington **24**:102. (Substitute for *nebrascensis* Mearns.)

Type locality.—Calf Creek, Custer County, Montana.

Distribution.—Northwestern corner of Oklahoma Panhandle. Recorded only from the Mesa de Maya biotic district.

Records.—Cimarron Co., Kenton (CM and LSU), Tesequite Canyon (TU).

Remarks.—The race *osgoodi* probably intergrades with the race *nebrascensis* in the Short-grass Plains biotic district.

Peromyscus maniculatus nebrascensis (Coues).—DEERMOUSE.

1877. *Hesperomys sonoriensis* var. *nebrascensis* Coues, Monogr. N. Amer. Rodentia: 79.

Type locality.—Deer Creek, western Nebraska.

Distribution.—Approximately the western half of the main part of Oklahoma, and westward through most of the Panhandle. Recorded from the Mixed-grass Plains, Mesquite Plains, Short-grass Plains, and Wichita Mountain biotic districts.

Records.—Alfalfa Co., 3 miles east of Cherokee (OU); Canadian Co., Fort Reno (Osgood, 1909: 82); Cleveland Co., Norman (KU); Comanche Co., Chattanooga and Mount Scott P. O. (Osgood, 1909: 82); Dewey Co., 5 miles west of Canton (KU); Garfield Co., Enid (KU); Harmon Co., Buck Creek, extreme southwestern corner of state (UM); Jackson Co., 14 miles south of Olustee (UM); Major Co., 3 miles south of Cleo Springs (OU), Graver Creek, 9 miles southwest of Togo (UM); Texas Co., Tepee Creek *(AM);* Woods Co., 2 miles west of Edith and 3 miles southwest of Waynoka (OU), 5 miles south of Waynoka (UM; "North Beaver" (=North Canadian) River *(AM);* "Beaver Co." (=Panhandle), "North Beaver" (=North Canadian) River (Osgood, 1909: 82).

Remarks.—The deermouse of western Oklahoma, exclusive of the Mesa de Maya district, is somewhat darker and more richly colored than typical *nebrascensis*. However, it more nearly resembles *nebrascensis* than any other race. In Oklahoma, the race *nebrascensis* intergrades with *ozarkiarum* at the approximate eastern border of the Mixed-grass Plains biotic district, and probably intergrades with *osgoodi* in the Short-grass Plains district.

Peromyscus maniculatus ozarkiarum Black.—DEERMOUSE.

1935. *Peromyscus maniculatus ozarkiarum* Black, Journ. of Mammalogy **16**:144.

Type locality.—Three miles south of Winslow, Washington County, Arkansas.

Distribution.—Approximately the eastern half of the main part of Oklahoma except the extreme southeastern corner. Recorded from the Ozark, Ouachita, Cherokee Prairie, and Osage Savanna biotic districts, and from the eastern edge of the Mixed-grass Plains district.

Records.—Adair Co., 7 miles west of Stilwell (KU); Le Flore Co., 2 miles northwest of Stapp and 1 mile northeast of Zoe (OU); Lincoln Co., 6 miles southeast of Perkins (OAMC); McClain Co., 10 miles southwest of Norman (OU); Muskogee Co., 8 miles southeast of Muskogee and 3 miles east of Wainwright (OU); Payne Co., Boomer Lake and Stillwater (OAMC); Pottawatomie Co., Tecumseh (KU); Rogers Co., Garnett (Blair, 1938: 501); Tulsa Co., south edge of Mohawk Park *(idem).* Red Fork (Osgood, 1909: 82).

Remarks.—The deermouse occupies grassland habitats in the biotic districts of eastern Oklahoma. Westward, the race *ozarkiarum* intergrades with *nebrascensis* at the approximate western limits of the Osage Savanna biotic district.

Peromyscus leucopus leucopus (Rafinesque).—WOOD-MOUSE.

1818. *Musculus leucopus* Rafinesque, American Monthly Magazine **3**:446 (*fide* Osgood, 1909: 113).

Type locality.—Western Kentucky; assumed to be near the mouth of the Ohio River.

Distribution.—Southeastern Oklahoma. Recorded from the Ouachita biotic district and the southern part of the Osage Savanna district.

Records.—Latimer Co., Red Oak (Osgood, 1909: 117); Le Flore Co., 1 mile northeast of Zoe (OU); McCurtain Co., 2 miles west of Smithville (OU); Murray Co., Arbuckle Mountains (CM), Sulphur (OAMC); Muskogee Co., Fort Gibson (Osgood, 1909: 117); Pittsburg Co., Hartshorne *(idem)*.

Remarks.—The race *leucopus* is replaced west of the Osage Savanna district by *texanus* and north of the eastern extension of the Osage Savanna district by *noveboracensis*. A specimen from Orlando, Logan County, was referred by Osgood (1909:117) to *leucopus*. This specimen was not examined, but other specimens from that region are referred to *noveboracensis*, so that specimen also is assigned to *noveboracensis*.

Peromyscus leucopus noveboracensis (Fischer).—WOOD-MOUSE.

1829 [*Mus sylvaticus*] δ *noveboracensis* Fischer, Synopsis Mammalium: 318 (*fide* Miller, 1924: 335).

Type locality.—New York.

Distribution.—Northeastern Oklahoma. Recorded from the Ozark, Cherokee Prairie, and Osage Savanna biotic districts, and from the northeastern part of the Mixed-grass Plains district.

Records.—Adair Co., 5 miles south of Kansas (UM); Cherokee Co., 2 miles north of Scraper (UM); Logan Co., Orlando (Osgood, 1909: 117); Osage Co., 2 miles southwest of Okesa and 10 miles northeast of Pawhuska (UM), 7 miles north, 5 miles east of Wynona (OAMC); Pawnee Co., 1 mile north of Ralston (OAMC); Payne Co., Boomer Lake Dam and Stillwater (OAMC); Rogers Co., Garnett (Blair, 1938: 501); Tulsa Co., mouth of Mingo Creek and Mohawk Park *(idem)*.

Remarks.—The race *noveboracensis* intergrades with *texanus* at the approximate boundary between the Osage Savanna and Mixed-grass Plains biotic districts. The race *noveboracensis* changes slightly and gradually southward into *leucopus*. No sharp line of demarcation between *leucopus* and *noveboracensis* can be drawn in Oklahoma, but the lower Arkansas Valley region seems to be the most satisfactory place to separate the ranges of the 2 races.

Peromyscus leucopus tornillo Mearns.—WOOD-MOUSE.

1896. *Peromyscus tornillo* Mearns, Preliminary diagnoses of new mammals from the Mexican border of the United States: 3 (Reprint: Proc. U. S. Nat. Mus. **18**:445.)

Type locality.—Rio Grande, about 6 miles above El Paso, El Paso County, Texas.

Distribution.—Southwestern corner of main part of Oklahoma and western tip of Panhandle, and probably also most of the Panhandle. Recorded from the Mesa de Maya and Mesquite Plains biotic districts, and probably occurs also in the Short-grass Plains district.

Records.—Cimarron Co., Kenton (CM), 3 miles north of Kenton (UM), Taft Canyon and Tesequite Canyon (TU); Harmon Co., Buck Creek, extreme southwestern corner of state (UM); Jackson Co., 14 miles south of Olustee (UM).

Remarks.—In northwestern Oklahoma the race *tornillo* probably intergrades with *texanus* in the Short-grass Plains biotic district. Specimens from the Mesquite Plains district in southwestern Oklahoma are somewhat intermediate between *tornillo* and *texanus*, but are best referred to *tornillo*.

In the Mesa de Maya district, the wood-mouse was taken on rocky, brush-covered canyon walls. In the Mesquite Plains district, it was found on slopes covered by mesquite, juniper, *Ephedra*, and other shrubs, and in the cottonwood zone along streams.

Peromyscus leucopus texanus (Woodhouse).—WOOD-MOUSE.

1853. *Hesperomys texana* Woodhouse, Proc. Acad. Nat. Sci. Philadelphia **6**:242.

Type locality.—Probably the vicinity of Mason, Mason County, Texas. (See Osgood, 1909: 129).

Distribution.—Approximately the western half of the main part of Oklahoma except the southwestern corner. Recorded from the Mixed-grass Plains and Wichita Mountain biotic districts.

Records.—Caddo Co., Apache, 11 miles southwest of Fort Cobb, and 17 miles southeast of Fort Cobb (Osgood, 1909: 124); Cleveland Co., Noble *(idem)*, Norman (KU); Comanche Co., Chattanooga, Lawton, and Wichita Mountains (Osgood, 1909: 124); McClain Co., 4 miles south of Norman (OU); Woods Co., Alva (*MCZ* and Osgood, 1909: 124), Waynoka (TU), 5 miles south of Waynoka (UM), White Horse Spring (Osgood, 1909: 124).

Remarks.—The wood-mouse of the western half of the main part of Oklahoma was referred rather hesitantly by Osgood (1909: 124) to the race *aridulus*. Osgood remarked *(idem)* that, if not referred to *aridulus*, it should be assigned to the race *texanus*. The material examined by the author indicates a closer relationship to the relatively dark, small-eared *texanus* than to the paler, larger-eared *aridulus*.

In Oklahoma, the race *texanus* intergrades with *leucopus* at the approximate eastern boundary of the southern part of the Mixed-grass Plains biotic district; with *noveboracensis* at the approximate eastern boundary of the northern part of the district; and with *tornillo* in the southwestern corner of the state, and probably in the Short-grass Plains district.

The race *texanus* is distributed along wooded streams in Oklahoma and occurs also on sand dunes where there is a cover of sand sage, bunch grasses, and sand plums. On the sand dunes it is associated with the deermouse *(Peromyscus maniculatus nebracensis)*.

Peromyscus gossypinus megacephalus (Rhoads).—COTTON-MOUSE.

1894. *Sitomys megacephalus* Rhoads, Proc. Acad. Nat. Sci. Philadelphia: 254.

Type locality.—Woodville, Jackson County, Alabama.

Distribution.—Southeastern Oklahoma. Recorded from the Mississippi and Ouachita biotic districts.

Records.—Latimer Co., Red Oak (Osgood, 1909: 139); LeFlore Co., northwest side of Rich Mountain (OU); McCurtain Co., 14 miles southeast of Broken Bow and 2 miles west of Smithville (OU), 2 miles west of Eagletown and Glover (UM).

Remarks.—The cotton-mouse was found to be abundant in June, 1938, on frequently-flooded terraces of the Glover River, near Glover, McCurtain County. The flood-plains were occupied by a mesic, hardwood forest, and the ground-floor was covered by a dense growth of an unidentified species of mint.

Peromyscus boylii rowleyi (Allen).—BRUSH MOUSE.

1893. *Sitomys rowleyi* Allen, Bull. Amer. Mus. Nat. Hist. **5**:76.

Type locality.—Noland Ranch, San Juan County, Utah.

Distribution.—Western tip of Oklahoma Panhandle. Recorded only from the Mesa de Maya biotic district.

Records.—Cimarron Co., 3 miles north of Kenton (UM).

Remarks.—The brush mouse is abundant in the brushy canyons of the Mesa de Maya district. So far as now known the race *rowleyi* does not intergrade in Oklahoma with *attwateri* of eastern Oklahoma. The ranges of the 2 are separated by the Mixed-grass Plains and Short-grass Plains districts, from which the species has not been recorded. Intergradation of the 2 races, however, is said to take place in western Texas (Osgood, 1909: 146).

Peromyscus boylii attwateri Allen.—BRUSH MOUSE.

1895. *Peromyscus attwateri* Allen, Bull. Amer. Mus. Nat. Hist. **7**:330.

1896. *Peromyscus bellus* Bangs, Proc. Biol. Soc. Washington **10**:137. (Stilwell, Adair County, Oklahoma.)

Type locality.—Turtle Creek, Kerr County, Texas.

Distribution.—Wichita Mountains and approximately the eastern half of Oklahoma except the southeastern corner. Recorded from the Wichita Mountain, Osage Savanna, Cherokee Prairie, Ouachita, and Ozark biotic districts.

Records.—Adair Co., Stilwell (Osgood, 1909: 149), 5 miles south of Kansas (UM); Comanche Co., Wichita Mountains (Osgood, 1909: 149); Latimer Co., Red Oak *(idem)*; Le Flore Co., 1 mile southwest of Summerfield (UM), Zoe (OU); (UM); Comanche Co., Wichita Mountains (Osgood, 1909: 149); Latimer Co., Red Mayes Co., Locust Grove (UM); McCurtain Co., 2 miles west of Smithville (OU); Murray Co., Dougherty (Osgood, 1909: 149); Osage Co., 2 miles southwest of Okesa and 10 miles northeast of Pawhuska (UM); Rogers Co., Twin Lakes (Blair, 1938: 502); Sequoyah Co., Redland (Osgood, 1909: 149).

Remarks.—The brush mouse generally is the most abundant small mammal in rocky ravines and on rocky, wooded bluffs in eastern Oklahoma.

Peromyscus truei truei (Shufeldt).—LEAF-EARED MOUSE.

1885. *Hesperomys truei* Shufeldt, Proc. U. S. Nat. Mus. **8**:407.

Type locality.—Fort Wingate, McKinley Co., New Mexico (See Osgood, 1909: 166).

Distribution.—Northwestern corner of Oklahoma Panhandle. Recorded only from the Mesa de Maya biotic district.

Record.—Cimarron Co., Tesequite Canyon (TU).

Remarks.—The leaf-eared mouse is a saxicolous species that ranges into Oklahoma in the rocky canyons of the Mesa de Maya district. The Oklahoma record extends the range of the species a short distance eastward from northeastern New Mexico.

Peromyscus nasutus nasutus (Allen).—JUNIPER-MOUSE.

1891. *Vesperimus nasutus* Allen, Bull. Amer. Mus. Nat. Hist. **3**:299.

Type locality.—Estes Park, Larimer County, Colorado.

Distribution.—Northwestern tip of Oklahoma Panhandle. Recorded only from the Mesa de Maya biotic district.

Records.—Cimarron Co., 3 miles north of Kenton (UM), Taft Canyon, and Tesequite Canyon (TU).

Remarks.—This saxicolous species probably does not extend into Oklahoma beyond the limits of the Mesa de Maya district. The specimen obtained near Kenton was taken in a rocky ravine in which the wood-mouse *(Peromyscus leucopus tornillo)* and brush mouse *(Peromyscus boylii rowleyi)* also were caught. The Oklahoma records extend the range of the juniper-mouse a short distance eastward from northeastern New Mexico.

Peromyscus nuttalli aureolus (Audubon and Bachman).—GOLDEN-MOUSE.

1841. *Mus (Calomys) aureolus* Audubon and Bachman, Proc. Acad. Nat. Sci. Philadelphia **1**:98.

Type locality.—"In the oak forests of South Carolina."

Distribution.—Southeastern Oklahoma. Recorded from the Mississippi and Ouachita biotic districts and from the eastern extension of the Osage Savanna district.

Records.—McCurtain Co., 15 miles southeast of Broken Bow and 2 miles west of Smithville (OU); Sequoyah Co., Redland (Osgood, 1909:226).

Remarks.—The golden-mouse is one of the characteristic small mammals of the Mississippi and Ouachita biotic districts.

Oryzomys palustris texensis Allen.—RICE-RAT.

1894. *Oryzomys palustris texensis* Allen, Bull. Amer. Mus. Nat. Hist. **6**:177.

Type locality.—Rockport, Arkansas County, Texas.

Distribution.—Extreme southeastern corner of Oklahoma. Recorded only from the Mississippi biotic district.

Records.—McCurtain Co., 15 miles southeast of Broken Bow (Whitaker, 1937: 102).

Remarks.—The rice-rat is a Gulf coastal plain species which occurs in marshy habitats in the Mississippi district.

Sigmodon hispidus texianus (Audubon and Bachman).—COTTON-RAT.

1853. *Arvicola texiana* Audubon and Bachman, Quadr. N. Amer. **3**:229. (*fide* Miller, 1924: 370).

Type locality.—Brazos River, Texas.

Distribution.—Eastern Oklahoma, west as far as the Wichita Mountains. Recorded from the Mississippi, Ouachita, Ozark, Cherokee Prairie, Osage Savanna, Wichita Mountain, and Mixed-grass Plains biotic districts.

Records.—Adair Co., 7 miles west of Stilwell(KU); Alfalfa Co., western edge of Cherokee Plain (Jackson and Warfel, 1933: 71); Cleveland Co., Noble (Elliot, 1907: 246), Norman (OU); Comanche Co., Wichita National Forest (LSU); Creek Co., Sapulpa (KU); Le Flore Co., 2 miles northwest of Stapp and 1 mile northwest of Zoe (OU); Logan Co. (OU); Major Co., 3 miles south of Cleo Springs (OU); McCurtain Co., 15 miles southeast of Broken Bow (OU), 2 miles west of Eagletown (UM); Murray Co., Dougherty (Elliot, 1907: 246); Muskogee Co., 3 miles east of Wainwright (OU); Payne Co., Stillwater (OAMC); Rogers Co., Garnett (Blair, 1938: 503); Tulsa Co., Mohawk Park and 2 miles southeast of Owasso *(idem)*.

Remarks.—The cotton-rat has its center of abundance in the Gulf coastal plain. In Oklahoma this species is largely confined to grassy and marshy vegetation associated with the streams and stream valleys, and in such situations it extends westward to the Wichita Mountain district and to the central Mixed-grass Plains district. In the Cherokee Prairie district, the cotton-rat is abundant in the tall-grass prairie type of habitat, and in times of great population pressure it spreads into the mixed-grass type of habitats (Blair, 1938: 503).

The specimens from Comanche County in the Wichita Mountain district and Major County in the Mixed-grass Plains district are paler in color than the specimens from the biotic districts of eastern Oklahoma.

Neotoma floridana osagensis Blair.—Eastern Woodrat.

1939. *Neotoma floridana osagensis* Blair, Occas. Pap. Mus. Zool. Univ. Mich. No. 403:5.

Type locality.—Okesa, Osage County, Oklahoma.

Distribution.—Approximately the eastern two-thirds of the main part of Oklahoma. Known in Oklahoma from the Ozark, Ouachita, Mississippi, Cherokee Prairie, Osage Savanna, Wichita Mountain, and Mixed-grass Plains biotic districts.

Records.—Adair Co., 5 miles south of Kansas (UM), Stilwell (*MCZ* and Goldman, 1910: 26), 7 miles west of Stilwell (KU); Blaine Co., Salt Creek Canyon (KU); Cleveland Co., Noble (FM), Norman (OU), South Canadian River, 2 miles south of Norman (KU); Comanche Co., Chattanooga and Mount Scott (Goldman, 1910: 26), Wichita National Forest (OU); Creek Co. (KU); Kay Co., Ponca Agency (Goldman, 1910: 26); Latimer Co., Red Oak *(idem)*; Le Flore Co., Zoe (OU); Lincoln Co., 3 miles south of Perkins (OAMC); McCurtain Co., 15 miles southeast of Broken Bow and 2 miles west of Smithville (OU); Murray Co., Dougherty (FM), Sulphur (OAMC); Osage Co., Conway Springs (TU), 2 miles southwest of Okesa and 10 miles northeast of Pawhuska (UM); Payne Co., Stillwater (OAMC); Pittsburg Co., Savanna (Goldman, 1910: 26); Pottawatomie Co., 7 miles southeast of Tecumseh (KU); Rogers Co., 2 miles west of Catoosa and Garnett (Blair, 1938:504); Tulsa Co., Red Fork (Goldman, 1910: 26).

Remarks.—This woodrat generally is associated with rocky bluffs and wooded, rocky ravines, but it occurs also in the oak—elm flood-plain forest in the biotic districts of eastern Oklahoma.

The specimen from 15 miles southeast of Broken Bow approaches the race *rubida* in its dark color and long tail, and possible should be referred to that

race. The series from Smithville shows a tendency toward *rubida*, but is best referred to *osagensis*.

Neotoma micropus micropus Baird.—PLAINS WOODRAT.

1855. *Neotoma micropus* Baird, Proc. Acad. Nat. Sci. Philadelphia: 333.

1899. *Neotoma macropus* [*sic*] *surberi* Elliot, Field Columb. Mus., publ. 37, zool. ser., **1**:279. (Three miles west of Alva, Woods County, Oklahoma).

Type locality.—Charco Escondido, Tamaulipas, Mexico.

Distribution.—Western one-third of main part of Oklahoma. Recorded from Mesquite Plains district and western part of Mixed-grass Plains district.

Records.—Harper Co., 4 miles north of Laverne (UM); Jackson Co., 14 miles south of Olustee (UM); Major Co., 5 miles west of Orienta (OU); Woods Co., 3 miles west of Alva and White Horse Spring (FM), 2 miles west of Edith (OU), Waynoka (TU), 5 miles south of Waynoka (UM); Woodward Co., Woodward (Goldman, 1910: 28).

Remarks.—The plains woodrat inhabits both rocky canyons and open grassland. Its bulky nests of sticks, liberally augmented by the remains of prickly pear plants, often are built around mesquite and other thorny shrubs.

Neotoma micropus canescens Allen.—PLAINS WOODRAT.

1891. *Neotoma micropus canescens* Allen, Bull. Amer. Mus. Nat. Hist. **3**:285.

Type locality.—North Canadian River, near the Oklahoma—New Mexico line, Cimarron County, Oklahoma.

Distribution.—The Oklahoma Panhandle. Recorded from the Short-grass Plains biotic district, but possibly occurs also in the Mesa de Maya district.

Records.—Cimarron Co., "North Beaver" (=North Canadian) River, (Goldman, 1910: 29).

Remarks.—The type locality of the race *canescens* could not be in Beaver County, as given by Miller (1924: 378), since Allen stated in the original description of the race that the specimens were taken "on the North Beaver (=North Canadian) River, near the boundary line between the Indiana Territory [Oklahoma] and New Mexico." This fixes the type locality in Cimarron County, and on the North Canadian River near the Oklahoma—New Mexico boundary.

The race *canescens* supposedly intergrades with the slightly darker *micropus* in the eastern Short-grass Plains district.

Neotoma albigula warreni Merriam.—WHITE-THROATED WOODRAT.

1908. *Neotoma albigula warreni* Merriam, Proc. Biol. Soc. Washington **21**:143.

Type locality.—Gaume's Ranch, northwestern corner of Baca County, Colorado.

Distribution.—Northwestern corner of Oklahoma Panhandle. Recorded only from the Mesa de Maya biotic district.

Records.—Cimarron Co., Black Mesa (TU), Kenton (CM and LSU).

Remarks.—The white-throated woodrat is an inhabitant of rocky canyons and slopes. The species may possibly extend some distance eastward into the

Short-grass Plains district in the canyons of the Cimarron River. The Oklahoma records extend the range of the species a short distance eastward from northeastern New Mexico.

Neotoma mexicana fallax Merriam.—MEXICAN WOODRAT.

1894. *Neotoma fallax* Merriam, Proc. Biol. Soc. Washington **9**:123.

Type locality.—Gold Hill, Boulder County, Colorado.

Distribution.—Northwestern corner of Oklahoma Panhandle. Recorded only from the Mesa de Maya biotic district.

Records.—Cimarron Co., Tesequite Canyon (TU).

Remarks.—The Mexican woodrat is a saxicolous species that ranges into Oklahoma in the rocky canyons of the Mesa de Maya district. The Oklahoma records extend the range of the Mexican woodrat a short distance eastward from northeastern New Mexico.

Microtus ochrogaster (Wagner).—PRAIRIE VOLE.

1842. *Hypudaeus ochrogaster* Wagner, Schreber's Säugethiere, Suppl. **3**:592 (*fide* Miller, 1924: 419).

Type locality.—America.

Distribution.—Northeastern Oklahoma. Recorded only from the northern part of the Cherokee Prairie and Mixed-grass Plains districts, but probably occurs also in the northern part of the Osage Savanna district.

Records.—Canadian Co., Fort Reno (Bailey, 1900: 74); Logan Co., Orlando *(idem)*; Woods Co., Alva (FM); Rogers Co., Garnett (Blair, 1938: 504).

Remarks.—The prairie vole is an inhabitant of the tall grass prairie type of habitat, and it extends westward in Oklahoma in such situations. The species reaches both its western and southern limits in the state.

Pitymys nemoralis (Bailey).—PINE VOLE.

1898. *Microtus pinetorum nemoralis* Bailey, Proc. Biol. Soc. Washington **12**:89.

Type locality.—Stilwell, Adair County, Oklahoma.

Distribution.—Eastern Oklahoma, west to the Wichita Mountains. Recorded from the Ozark, Cherokee Prairie, Osage Savanna, and Wichita Mountain biotic districts, and from the eastern edge of the Mixed-grass Plains district.

Records.—Adair Co., Stilwell (Bailey, 1900: 66); Cleveland Co., Noble (Elliot, 1907: 301), Norman (KU and OU); Comanche Co., Indiahoma (LSU); Creek Co., Sapulpa (KU); Logan Co. (OU); Murray Co., Dougherty (Elliot, 1907: 301); Osage Co., 7 miles north and 5 miles east of Wynona (OAMC); Payne Co., Stillwater (OAMC); Pottawatomie Co., Tecumseh (KU); Rogers Co., Twin Lakes (Blair, 1938: 505); Tulsa Co., mouth of Mingo Creek and Mohawk Park *(idem)*.

Remarks.—The pine vole inhabits the most mesic flood-plain forests available, and in these rich flood-plain forests it extends across the biotic districts of eastern Oklahoma and into the grassland districts of central Oklahoma. The species is subject to great fluctuations in abundance, and in some years it will be the most common small mammal of the flood-plains, while in others it will be extremely rare. The record from Comanche County marks the western limit of the range of the species.

Ondatra zibethica cinnamomina (Hollister).—MUSKRAT.

1910. *Fiber zibethicus cinnamominus* Hollister, Proc. Biol. Soc. Washington **23**:125.

Type locality.—Wakeeney, Trego County, Kansas.

Distribution.—Probably most of Oklahoma from the Cherokee Prairie biotic district westward. Recorded from the Mixed-grass Plains, Osage Savanna, and Cherokee Prairie districts, but undoubtedly occurs also in the Short-grass Plains district.

Records.—Cleveland Co., Norman (OU); Garfield Co., *(KU);* Oklahoma Co., Oklahoma City (OU); Payne Co., Cimarron River near Perkins and Stillwater (OAMC); Tulsa Co., 2 miles north of Dawson and Mohawk Park (Blair, 1938:506), Red Fork (Hollister, 1911: 31); Woods Co., near Waynoka (Jackson and Warfel, 1933: 71).

Remarks.—The muskrat is distributed along the streams in Oklahoma, and in many places occurs even on very small creeks. No specimens of the muskrat are available from the Ozark, Ouachita, and Mississippi biotic districts in Oklahoma, but it is probable that those from the Ozark district would be referable to the species and race *zibethica,* and those from the Ouachita and Mississippi districts to the species *rivalicia.*

Zapus hudsonius campestris Preble.—JUMPING MOUSE.

1899. *Zapus hudsonius campestris* Preble, North Amer. Fauna **15**:20.

Type locality.—Bear Lodge Mountains, Crook County, Wyoming.

Distribution.—Known in Oklahoma only from the Cherokee Prairie biotic district.

Records.—Tulsa Co., Mohawk Park (Blair, 1938: 506).

Remarks.—The two specimens of the jumping mouse known from Oklahoma were taken in a lowland thicket, and the distribution of this species probably follows the stream systems. The Oklahoma records extend the known range of the jumping mouse southward from middle-eastern Kansas.

Erethizon expixanthum bruneri Swenk.—PORCUPINE.

1916. *Erethizon epixanthum bruneri* Swenk., Univ. Studies, Lincoln, Nebr., **16**:117.

Type locality.—Three miles east of Mitchell, Scottsbluff County, Nebraska.

Distribution.—Known in Oklahoma from the Mesa de Maya biotic district.

Record.—Cimarron Co., Tesequite Canyon (TU).

Remarks.—The porcupine possibly occurs also in the canyons of the Short-grass Plains district. The Oklahoma record extends the range of the species into Oklahoma from adjoining parts of Colorado and New Mexico.

Lepus californicus melanotis Mearns.—BLACK-TAILED JACKRABBIT.

1890. *Lepus melanotis* Mearns, Bull. Amer. Mus. Nat. Hist. **2**:297 (*fide* Miller, 1924: 460).

Type locality.—Independence, Montgomery County, Kansas.

Distribution.—All of Oklahoma except the eastern forests. Recorded from the Short-grass Plains, Mixed-grass Plains, Mesquite Plains, Wichita Mountain, Osage Savanna, and Cherokee Prairie biotic districts, and undoubtedly occurs also in the Mesa de Maya district.

Records.—Alfalfa Co., 4 miles southeast of Cherokee (OU); Beaver Co., 4 miles west of Forgan and 3 miles southwest of Turpin (WFB); Canadian Co., Yukon *(KU);* Cimarron Co., 12 miles west of Boise City (WFB); Cleveland Co., 3 miles east of Norman (OU); Comanche Co., Mount Scott (Nelson, 1909: 148), Wichita National Forest (OU); Creek Co., Sapulpa *(KU);* Dewey Co. *(KU);* Garfield Co., Enid *(KU);* Grant Co., 5 miles west of Lamont (WFB); Harper Co., 4 miles north of Laverne (UM), 5 miles east of Rosston (WFB); Jackson Co., 14 miles south of Olustee (WFB); Muskogee Co., 3 miles east of Wainwright (OU); Osage Co., 13 miles southeast of Fairfax (WFB); Payne Co., Stillwater (OAMC); Pottawatomie Co., Tecumseh *(KU),* 1 mile west of Tecumseh (OAMC); Rogers Co., Garnett (Blair, 1938: 506); Texas Co., 10 miles northwest of Guymon and 10 miles east of Hooker (WFB); Tulsa Co., 8 miles west of Red Fork (Nelson, 1909: 148); Woods Co., Alva *(idem),* White Horse Spring (Elliot, 1907: 380); "Neutral Strip" (=northwestern part of main section of state) (AM and Nelson, 1909: 148); "Beaver" (= North Canadian) River *(AM);* "Bear River" (possibly Bear Creek, Carter Co.) Nelson, 1909: 148).

Remarks.—The black-tailed jackrabbit is one of the most characteristic species of the Short-grass Plains and Mixed-grass Plains biotic districts. The specimens from the Osage Savanna and Cherokee Prairie districts average slightly darker than specimens from the districts of western Oklahoma.

Sylvilagus floridanus alacer (Bangs).—Eastern Cottontail.

1896. *Lepus sylvaticus alacer* Bangs, Proc. Biol. Soc. Washington **10**:136.

Type locality.—Stilwell, Adair County, Oklahoma.

Distribution.—Approximately the eastern half of the main part of Oklahoma. Recorded from the Ozark, Ouachita, Mississippi, Cherokee Prairie, and Osage Savana biotic districts, and the extreme eastern edge of the Mixed-grass Plains district.

Records.—Adair Co., Stilwell (Nelson, 1909: 176); Bryan Co., 3 miles southeast of Yuba (UM); Cherokee Co., 5 miles west of Tahlequah (WFB); Cleveland Co., Norman (OU and *KU);* Creek Co., Sapulpa *(KU);* Garfield Co., Enid *(KU);* Logan Co. (OU); McClain Co., 10 miles southwest of Norman (OU); McCurtain Co., 14 miles southeast of Broken Bow and 2 miles west of Smithville (OU); Muskogee Co., 3 miles east of Wainwright (OU); Noble Co., Otoe Indian Reservation north of Morrison (OAMC); Pittsburg Co., Savanna (Nelson, 1909: 176); Pottawatomie Co., 7 miles southeast of Tecumseh *(KU);* Payne Co., 2 miles west of Stillwater (OAMC); Rogers Co., Garnett (Blair, 1938: 506); Sequoyah Co. *(KU),* 2 miles south of Sallisaw (WFB); Tulsa Co., 1 mile north of Dawson (Blair, 1938: 506), Red Fork (Nelson, 1909: 176); Wagoner Co., 6 miles west of Wagoner (WFB).

Remarks.—The race *alacer* of the eastern cottontail ranges over the biotic districts of eastern Oklahoma and intergrades in the eastern Mixed-grass Plains district with the race *llanensis* of western Oklahoma.

Sylvilagus floridanus llanensis Blair.—Eastern Cottontail.

1938. *Sylvilagus floridanus llanensis* Blair, Occas. Pap. Mus. Zool. Univ. Mich. **380**:1.

Type locality.—Old "F" Ranch headquarters, Quitaque, Briscoe County, Texas.

Distribution.—Approximately the western half of the main part of Oklahoma. Recorded from the Short-grass Plains, Mesquite Plains, and Wichita Mountain biotic districts, and from the western part of the Mixed-grass Plains district.

Records.—Blaine Co. *(KU)*; Caddo Co., Fort Cobb (Nelson, 1909: 176); Comanche Co., Mount Scott *(idem)*, Wichita National Forest (OU); Dewey Co. *(KU)*; Harper Co., 4 miles north of Laverne (UM); Jackson Co., 14 miles south of Olustee (UM); Woods Co., Waynoka (TU), 5 miles south of Waynoka (UM); Woodward Co., Woodward (Nelson, 1909: 176).

Remarks.—This race of the eastern cottontail is distributed along stream valleys and in areas of sand dunes in western Oklahoma. It intergrades in the eastern Mixed-grass Plains biotic district with the race *alacer* of eastern Oklahoma. The specimens recorded by Nelson (1909: 176) were referred by him to *alacer*. These specimens have not been examined, but other specimens from the region are referable to *llanensis*. Therefore, Nelson's specimens also are referred to *llanensis*.

Sylvilagus audubonii neomexicanus Nelson.—DESERT COTTONTAIL.

1907. *Sylvilagus audubonii neomexicanus* Nelson, Proc. Biol. Soc. Washington **20**:83.

Type locality.—Fort Sumner, Guadalupe County, New Mexico.

Distribution.—Oklahoma Panhandle and western one-third of main part the state. Recorded from the Mesa de Maya, Short-grass Plains, Mixed-grass Plains, Mesquite Plains, and Wichita Mountain biotic districts.

Records.—Cimarron Co., Black Mesa (TU), 3 miles north of Kenton (UM); Comanche Co., Chattanooga (Nelson, 1909: 236), Wichita National Forest (OU); Jackson Co., 14 miles south of Olustee (UM); Texas Co. (KU), Tepee Creek (Nelson, 1909: 236); "Neutral Strip" (=northwestern part of main section of state) *(idem)*.

Remarks.—The desert cottontail extends into Oklahoma from the west and reaches its eastern limit in the Mixed-grass Plains biotic district.

Sylvilagus aquaticus aquaticus (Bachman).—SWAMP-RABBIT.

1837. *Lepus aquaticus* Bachman, Journ. Acad. Nat. Sci. Philadelphia, ser. 1, **7**:319.
1899. *Lepus telmalemonus* Elliot, Field Columb. Mus., publ. 38, zool. ser., **1**:285 (Washita River, near Dougherty, Murray County, Oklahoma).

Type locality.—Western Alabama.

Distribution.—Eastern half of the main part of Oklahoma. Recorded from the Mississippi, Ouachita, Cherokee Prairie, and Osage Savanna biotic districts and from the eastern edge of the Mixed-grass Plains district. Undoubtedly occurs also in the Ozark district, as it is known from southeastern Kansas

Records.—Latimer Co., Red Oak (Nelson, 1909: 273); Le Flore Co., 6 miles west of Heavener (OU); McCurtain Co., 14 miles southeast of Broken Bow (OU), 8 miles southwest of Eagletown and 6 miles northeast of Idabel (WFB); Murray Co., Dougherty (FM); Payne Co., 7 miles northwest of Stillwater (OAMC); Pittsburg Co., Hartshorne (Nelson, 1909: 273); Pottawatomie Co., 7 miles southeast of Tecumseh *(KU)*; Rogers Co., Catoosa (Blair, 1938: 507); Tulsa Co., Mohawk Park *(idem)*; Washington Co., 8 miles north of Collinsville (OAMC).

Remarks.—The swamp-rabbit is a typical Gulf coastal plain species that ranges widely in the Mississippi biotic district and extends along wooded and brushy flood-plains into the other biotic districts of eastern Oklahoma.

The specimens from Oklahoma average slightly paler and grayer than specimens from Alabama and Georgia. However, the average differences are so slight and there is so much difference due to differences in pelages in the avail-

able material that it seems desirable at present to follow Nelson (1909: 272) and consider *telmalemonus* Elliot a synonym of *aquaticus*.

Cervus merriami Nelson.—ELK.

1902. *Cervus merriami* Nelson, Bull. Amer. Mus. Nat. Hist. **16**:7.

Type locality.—Head of Black River, White Mountains, Apache County, Arizona.

Distribution.—Known to have occurred in Oklahoma in the Wichita Mountain biotic district.

Records.—Kiowa Co., Rainy Mountain (Bailey, 1905: 60); Comanche Co., Wichita Mountains (Marcy, 1854: 201).

Remarks.—It is known that the elk occurred in the Wichita Mountains, and the accounts of early travelers indicates that it possibly occurred in other parts of western Oklahoma. The species of elk that inhabited the Wichita Mountains is not definitely known, and Bailey (1905: 60) suggested that it might be referable to the species *canadensis*.

Odocoileus virginianus macrourus (Rafinesque).—WHITE-TAIL DEER.

1817. *Cervus* (misspelled *Corvus*) *macrourus* Rafinesque, American Monthly Magazine **1**:436.

Type locality.—Plains of Kansas River, Upper Mississippi Valley.

Distribution.—Oklahoma Panhandle and western half of main part of state. Recorded from the Short-grass Plains, Mixed-grass Plains, and Wichita Mountain biotic districts.

Records.—Comanche Co., Cache *(CMNH)*; Woodward Co. *(KU)*; (Cimarron or Texas Co.), "Beaver Creek (=North Canadian River) where it crosses the Texas and Oklahoma line at the north edge of the (Texas) Panhandle" (Bailey, 1905: 63).

Remarks.—No specimens of the white-tail deer are available from eastern Oklahoma, but it is probable that the animal of that region is referable to the race *louisianae*. The species is now exterminated or very rare in central Oklahoma, but it is probable that at one time *louisianae* and *macrourus* intergraded in the Osage Savanna district and in the eastern part of the Mixed-grass Plains district.

Antilocarpa americana americana (Ord).—PRONGHORN.

1815. *Antilope americana* Ord, Guthrie's Geography, 2nd Amer. ed., **2**:292 (*fide* Miller, 1924: 493).

Type locality.—"Plains and highlands of the Missouri."

Distribution.—Now extirpated in Oklahoma, but known to have occurred at one time over most of western Oklahoma. Recorded from the Mixed-grass Plains and Short-grass Plains biotic districts.

Records.—Ellis Co. (Snider, 1917: 184); Grant Co. (Fessler, 1929: 71); Kay Co. *(idem)*; "Above Cross Timbers" (west of Osage Savanna district) (Marcy, 1854: 201); "No Man's Land" (=Panhandle) *(KU)*; Oklahoma (no exact locality given), *(AM)*.

Remarks.—The pronghorn, as shown by the narratives of early travelers,

ranged over the western half of Oklahoma, where it apparently was very abundant.

Bison bison bison (Linnaeus).—PLAINS BISON.

1758. [*Bos*] *bison* Linnaeus, Syst. Nat., ed. 10, **1**:72.

Type locality.—Mexico.

Distribution.—Probably ranged at one time over at least the western half of Oklahoma. Now extirpated in the state, except for captive herds.

Records.—"Beaver Co." (=Panhandle) *(KU)*; Dewey Co. (Fessler, 1929: 71); Grant Co. *(idem)*; Woods Co. *(idem)*; "Above (west of) Cache Creek" (Marcy, 1854: 201).

Remarks.—The bison, if we are to believe the narratives of early travelers, existed at one time in almost countless numbers in the biotic districts of western Oklahoma. Today, except for a few captives, the bison is extirpated in the state.

Dasypus novemcinctus texanus (Bailey).—NINE-BANDED ARMADILLO.

1905. *Tatu novemcinctum texanum* Bailey, North Amer. Fauna **25**:52.

Type locality.—Brownsville, Cameron County, Texas.

Distribution.—Believed to be extending its range into eastern Oklahoma. Recorded from the Osage Savanna and Cherokee Prairie biotic districts.

Records.—Creek Co., Arkansas River Valley (Blair, 1936: 293); Rogers Co., 20 miles east of Tulsa *(idem)*.

Remarks.—The nine-banded armadillo is known to have extended its range eastward and northward in Texas in recent years. Occasional reports of its occurrence in Oklahoma lead to the belief that the species is extending its range into the state.

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Distribution, Taxonomy, Nomenclature, and Habits of the Little Tree-Frog (Hyla ocularis)

Francis Harper

This tiniest of North American frogs is currently known as *Pseudacris ocularis* (Holbrook). It has long been something of an anomaly as the only arboreal member of an otherwise terrestrial genus. For reasons that will gradually appear in the following pages, I believe its proper name is *Hyla ocularis* Bosc and Daudin.

Distribution

In southeastern Georgia this is one of the most widely distributed amphibian species. Some of the localities where I have seen or heard it during the past 18 years are the following: Okefinokee Swamp—Billy's, Black Jack, Bugaboo, Chesser's, Floyd's, and Jones' Islands, The Pocket, Suwannee Canal, Chesser's Prairie, Floyd's Island Prairie, and Honey Island Prairie; Camden County — Greenville; Charlton County — Camp Cornelia, Camp Pinckney, Dedge Pond, Folkston, Mattox, Murray Bay, Spanish Creek, Starling Branch, and Trader's Hill; Liberty County—Riceboro and Walthourville; Toombs County—Swift Creek, near Lyons; Ware County—Hebardville, Satilla River, Suwannee Lake, and Waycross. Mr. and Mrs. E. V. Komarek collected a specimen between January 18 and February 1, 1936, at Sherwood Plantation, Grady County, and T. Lloyd Cadbury collected one on March 28, 1937, in the Altamaha River swamp west of Ludowici, Long County.

I have also a few records from northeastern Florida: along the St. Mary's River north of Macclenny, in Baker County; and at Callahan, in Nassau County.

Detailed locality records from South Carolina are so few as to make it worth while to mention a specimen taken by J. A. G. Rehn and Morgan Hebard on September 4, 1911, at Yemassee, Beaufort County, and one taken by Dr. Witmer Stone in May, 1917, at Manning, Clarendon County (Nos. 19368 and 19820, Acad. Nat. Sci. Philadelphia).

The following references to the species comprise practically all that I have noted in the literature. The various locality records included with them indicate the general distribution.

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Hyla ocularis (Holbrook): Noble, Am. Mus. Novit., no. 70, p. 2, figs. 1-4, 1923 (taxonomy; nomenclature; Wilmington, "South" [=North] Carolina; Hampton County, S. C.; Lee County, Arlington, and Jacksonville, Fla.); Myers, Copeia, no. 131, p. 59, 1924 (Wilmington, N. C.).

Hyla ocularis "Latreille": Sherborn, Index Animalium 1801-50, pt. 18, p. 4538, 1929.

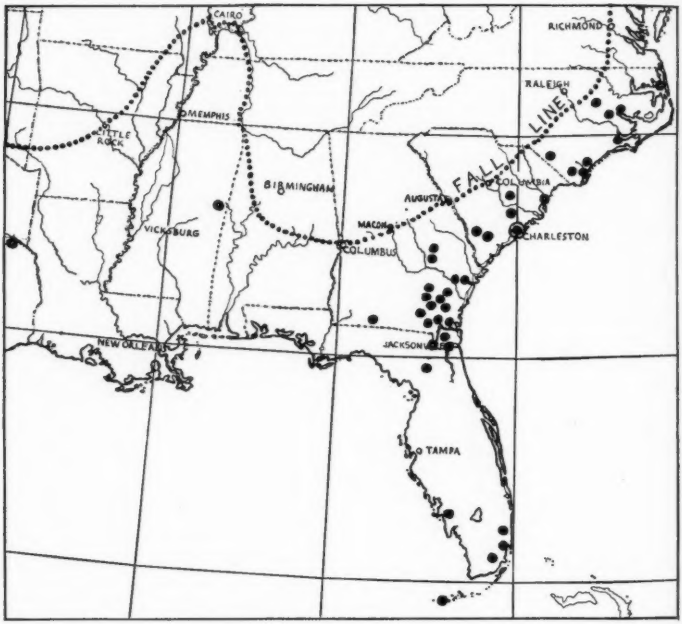

Fig. 1. Distributional map of *Hyla ocularis*. (The encircled dot represents the type locality.)

The range of the species may be briefly defined as follows: Atlantic and Gulf Coastal Plain, from northeastern North Carolina to southern Florida and eastern Texas.

The localities from which the species has been recorded, as indicated above, are shown as far as possible on the accompanying map (Fig. 1). In the case, however, of various closely adjacent localities in southeastern Georgia, space has not sufficed to represent them all.

It may be of some slight historical interest to list here the first state records, as nearly as they can be judged from the foregoing references and from an

account of Bartram's mentioned below. Florida: Bartram, 1775(?) and 1791. South Carolina: Bosc and Daudin, 1801. Georgia: Holbrook, 1838. North Carolina: Noble, 1923. Louisiana(?): Wright, 1929. Texas: Burt, 1936. Mississippi: Brandt, 1937. It can hardly be taken for granted that Bartram knew the species from South Carolina as well as from Florida; otherwise his would be the first record for the former state, too. Curiously enough, this frog seems so far to have escaped observation in Alabama, and apparently no record from a specific locality in Louisiana has been published.

Early History and Nomenclature

For a century past, *Hylodes ocularis* Holbrook (1938, ed. 1, vol. 3, p. 79) has been generally regarded as the original reference of the present species. However, Le Conte in 1855 (p. 429) records "*Hyla ocularis* Daudin" from Georgia, and True, in a virtually forgotten paper (1883, p. 241), lists "*Chorophilus ocularis* Daudin" from South Carolina; and just half a century still later Brandt and Walker (1933, p. 2) are inclined to consider "*Hyla ocularis* Daudin" (1803, vol. 8, p. 68) the first valid name. As a matter of fact, there are two prior uses of *Hyla ocularis*, besides another early name, which seem to have been either inaccessible to, or overlooked by, a majority of recent investigators. The complicated early history of the species may here be taken up in mainly chronological order.

The honor of being the earliest commentator belongs probably to William Bartram. In an account of the frogs of East Florida, he writes (MS, 1775?, vol. 2, p. 59):

"Besides these, there are a great variety of little Frogs that keep only in Savanahs & ponds in the Pine forests, some about one inch in length striped green & white makeing a noise like chickens others not biger then a Creeket & make a noise like them & in the savanahs as numerous as Grasshoppers are in Meadows."

The frogs referred to as "one inch in length striped green & white" were probably *Acris gryllus gryllus* (Le Conte), while the "others not biger then a Creeket" are here considered to be *Hyla ocularis*.

This preliminary account is amplified and made much more definite in Bartram's later discussion (1791, p. 278) of the frogs of Florida and Carolina:

"(6) There is yet an extreme diminutive species of frogs, which inhabits the grassy verges of ponds in savannas: these are called savanna crickets, are of a dark ash or dusky colour, and have a very picked nose. At the times of very great rains, in the autumn, when the savannas are in a manner inundated, they are to be seen in incredible multitudes clambering up the tall grass, weed, &c. round the verges of the savannas, bordering on the higher ground, and by an inattentive person might be taken for spiders or other insects. Their note is very feeble, not unlike the chattering of young birds or crickets."

The "extreme diminutive" size, the habit of "clambering up the tall grass," and the comparison of the "feeble" note to "the chattering of young birds or crickets," all apply rather unmistakably to the Little Tree-frog.

It is also quite evident from the above that Bartram employed the name of "savanna cricket" for *Hyla ocularis* rather than for *Acris gryllus gryllus*. If, as seems likely, Le Conte borrowed this common name from Bartram, he was mistaken in applying it (1825, p. 282) to *Acris*. He may have realized his mistake thirty years later, when he made the somewhat cryptic remark (1855, pp. 426-427) that *Acris* "was a few years ago commonly known by the name of Savannah Cricket."

The versatile French naturalist, L. A. G. Bosc (1759-1828), spent a considerable period (from 1796 to about 1798) in the vicinity of Charleston, S. C., meanwhile collecting a large amount of herpetological material and preparing descriptions and drawings of various new species. The results of these labors were turned over, at least in large part, to his friend Daudin (*cf.* Daudin, 1801, vol. 2, p. 153, and 1803, vol. 5, p. 6).

Daudin (1802, p. 12) makes the definite and apparently well substantiated claim that he prepared the descriptions of 38 species that were published in Sonnini and Latreille's "Histoire naturelle des Reptiles" (1801). All of these were included in Volume 2 of this four-volume work, and in that part of the volume for which Latreille assumed sole responsibility. *Hyla ocularis* was one of a number of new species included among the 38. Daudin's contributions were utilized in most cases without any very definite acknowledgment on the part of Latreille, and there has been no general recognition of his claims to the authorship of the new species involved.

Bosc's material furnished the basis for the description of *Hyla ocularis* in each of these three works: Sonnini and Latreille's "Histoire naturelle des Reptiles" (vol. 2, p. 187, 1801); Daudin's "Histoire naturelle des Rainettes, des Grenouilles et des Crapauds" (p. 32, 1802); and Daudin's "Histoire naturelle des Reptiles" (vol. 8, p. 68, 1803). That in Sonnini and Latreille is of special importance as the earliest description, and the work is so excessively rare in America that it seems desirable to quote the description in full:

"La Raine oculaire, Hyla ocularis.

"Elle est d'un gris argenté, finement pointillé de brun, avec une bande assez large, se prolongeant des yeux jusqu'au milieu des flancs.

"Sa longueur est de six à dix lignes au plus.

"Le dessous du ventre est granulé; le dessus des membres a des bandes transversales brunes; les doigts des pieds postérieurs sont demi-palmés, et ceux des antérieurs sont fendus.

"Bosc a fréquemment trouvé cette nouvelle espèce dans les grands bois de la Caroline, sur les arbres."

The descriptions of this species in Daudin's own two works (1802, pp. 32-33, and 1803, vol. 8, pp. 68-69) are essentially the same as the one just quoted; they employ many of the same expressions, but include a few additional details. The similarity may well strengthen belief in the same authorship of all three descriptions. Translations of some signficant remarks by Daudin follow:

"In the description of this *Hyla*, Bosc believes that it is probably the smallest species of the genus, and that it is only six lines in length; but I have observed several individuals which are as much as nine and ten lines, and one of them is at the Muséum d'Histoire Naturelle in Paris" (1802, p. 33).

"The description of this *Hyla* has been communicated to me with a specimen and a drawing by Bosc" (1803, vol. 8, p. 69).

On the page preceding the one last cited, Daudin includes the following references: "*La raine oculaire*. Daudin, Hist. nat. des reptiles par Latreille, in -18, tom. II, p. 187.... *Hyla ocularis*. Bosc, Note manuscrite communiquée."

It is perhaps worth noting that Merrem (1820, p. 172 bis) alone, among the early authors, credits the name *ocularis* to Latreille, while Sherborn (Index Animalium 1801-1850, p. 4538, 1929) is the only recent one to do so.

In Daudin's "Rainettes" an additional name for the species is inadvertently introduced, figure 2 on plate 4 being labeled "*Hyla oculata*." This name is disposed of at once as a still-born synonym of *ocularis*.

The color descriptions in the three different works apply satisfactorily and, in fact, rather unmistakably to the Little Tree-frog. Daudin's figure (1802, pl. 4, fig. 2), while no masterpiece of accuracy, fits this species at least as well as it does any of the other Hylidae of South Carolina. The occurrence in trees, as reported by Bosc, rules out every species of *Pseudacris*. If his six-line (13.5 mm.) specimen was adult, it could have been nothing else than the Little Tree-frog. Furthermore, this species is far more commonly *seen* than any Southeastern *Pseudacris*, and it is therefore quite logical that it should have been detected and described years in advance of any member of the last-mentioned genus.

On the other hand, it must be admitted that the maximum measurements of length given in these works (if taken in the same manner as today—from snout to vent, with dividers) exceed any thing recorded for the Little Tree-frog in recent times. The French "ligne" (line), as one twelfth of a "pouce" (inch). is equivalent to 2.25 mm. Daudin gives a maximum of 10 lines (22.5 mm.), whereas the greatest authentic length recorded in recent literature is 19 mm. (Brandt, 1937, p. 218). Holbrook, whose description and figure (1838, ed. 1, vol. 3, p. 79, pl. 14) form the basis for the current conception of the Little Tree-frog, actually gives a length of 11 lines! (An English line being 2.12 mm., 11 lines would be 23.3 mm.) Did Holbrook[1] and his predecessors take the measurement of length by some different method from our own, or did certain of these frog Lilliputians actually grow in those days to a sort of Brobdingnagian size?

Bosc, who had an advantage over his Parisian colleagues in knowing the Little Tree-frog in life, gave its length as six "lignes" (13.5 mm.) (Daudin, 1802, p. 33), which is a good average for males of this species. I would suggest the possibility that Daudin's specimens of 9 and 10 lines (20.25-22.5 mm.)

1 Holbrook's records of length are too great in the case of *Acris gryllus gryllus* (1.5 in.) and *Pseudacris nigrita nigrita* (1.5 in.) as well as *Hyla ocularis;* but well within the range of variation in the case of various other species, including *Pseudacris ornata, Hyla squirella, H. versicolor versicolor,* and *Microhyla carolinensis.*

were actually *Acris gryllus gryllus*, which, in perhaps a poor state of preservation, he did not distinguish from *Hyla ocularis*. To this extent the original description may have been composite; but as a whole, or in all characters save the maximum length, the description applies to *H. ocularis* rather than to *Acris*. It is significant that in neither Latreille nor Daudin do we find *Acris* described, although surely it was too abundant and conspicuous in South Carolina to have been overlooked by Bosc.

Aside from the apparently erroneous statement of maximum length, and in the light of our present knowledge of the frogs of the Southeastern States, we may safely conclude that the *Hyla ocularis* in the works of Latreille and of Daudin is unmistakably the Little Tree-frog. Holbrook himself regarded this as a distinct possibility; accordingly he retained the same specific name in describing *Hylodes ocularis* (1838, ed. 1, vol. 3, p. 79) from his own specimens, and remarked at the same time, "This animal may in the end prove to be the Hyla ocularis of Bosc and Daudin." Most subsequent herpetologists (save Le Conte), perhaps in part through personal unfamiliarity with the species in life, have been in the habit of regarding the frog of Latreille and of Daudin as indeterminable and of accepting Holbrook, with his more accurate description and figure, as authority for *ocularis*. Lately, however, as already mentioned, Brandt and Walker (1933, p. 2) have pointed out the probable identity of Holbrook's species with Daudin's. Their finding is here confirmed, although the original description occurs in an earlier work than the one cited by them.

The question of authorship of this description is a knotty one. We have learned from Daudin (1802, pp. 12, 33, and 1803, vol. 8, pp. 68 69) that he had before him a description of the species by Bosc, that the name *Hyla ocularis* was proposed in a manuscript of Bosc's, and that Daudin himself claimed credit for the description published in Sonnini and Latreille's work. Bosc's description must have been utilized at least in part in that work; certainly his measurement of the length is included. Evidently Daudin added at least some details (such as the length of 9 or 10 lines) and prepared the description for the press.

In another paper (in manuscript) I am discussing further aspects of this nomenclatural problem. Meanwhile I propose to credit *Hyla ocularis* to Bosc and Daudin jointly, and to restrict the type locality to the vicinity of Charleston, S. C.

The generic allocation will be discussed briefly at the end of the present paper.

Habitats

The Little Tree-frog occurs in an unusually wide variety of habitats. In the Okefinokee region it frequents pine barrens, grassy fields, cut-over hammocks, river hammocks, cypress bays (virgin and cut-over), sphagnous bogs, creek swamps, cypress ponds, and "prairies." Cypress ponds (Fig. 2) appear to constitute one of the most important breeding habitats; cypress bays, sphagnous bogs, and "prairies" evidently serve likewise. In former years, while

traveling along the lumber railways across sphagnous bogs at a time of heavy summer rainfall, one could hear its notes practically every rod of the way. Its numbers in such places are certainly great. In the swamp of Suwannee Creek it was found particularly during a severe drought (April, 1932), which may have forced it thither out of some of its drier habitats, such as the adjoining pine barrens.

This species is much of a grass frog. It is frequently noted in grassy or weedy fields, especially when these are more or less rain-flooded. The grassy edges of cypress ponds form a much favored haunt. It is also found abund-

Fig. 2. A breeding habitat of *Hyla ocularis*: a cypress pond on Chesser's Island, Okefinokee Swamp, Ga. Principal vegetation: pond cypress *(Taxodium ascendens)*, slash pine *(Pinus elliottii)*, sweet bay *(Tamala pubescens)*, pond spice *(Clabraria geniculata)*, "lather-bush" *(Clethra)*, "black bamboo" *(Smilax laurifolia)*, and Spanish moss *(Dendropogon usneoides)*. April 1, 1937.

antly among the grasses of the pine barrens. On the Okefinokee prairies it seems to affect particularly those parts where sphagnum and fern *(Anchistea virginica)* grow thickly.

Apparently no species of the genus *Pseudacris,* in which the Little Tree-frog was long included, ascends to an appreciable distance above a terrestrial habitat. In the ordinary round of its daily activities the present species is commonly seen leaping among grass-stems and perching there at heights up to a foot or more above the ground; at the time of its vocal performance it may be found in the grass, or it may ascend to a height of 3 or 4 feet on tree trunks or branches of shrubs. Some individuals may be seen chirping very close to the surface of cypress ponds, while perching on sticks, needles of fallen pines, grasses, or sedges. It has a penchant for sitting crosswise on its perch, whether this is a grass-stem, a twig, or a tree trunk; but sometimes it assumes a lengthwise, nearly upright position among grasses or on a shrub. I do not recall ever having seen one actually on the ground while chirping.

This species differs again from nearly all members of the genus *Pseudacris* in maintaining no contact with the water while engaged in its vocal performance. Holbrook's Chorus Frog *(P. ornata)* may either squat with its hind-quarters in the water or perch among grass-stems an inch or two above the surface. But the other forms of *Pseudacris* which I have noted in the act of calling—*feriarum, nigrita, septentrionalis,* and *triseriata* (New Jersey from)—have had at least their hind-quarters in the water. A similar position is maintained by *triseriata* in Michigan (*cf.* Thompson and Thompson, 1912, p. 48, pl. 4a), and perhaps by *brimleyi* (*cf.* Brandt and Walker, 1933, p. 5).

In view of the Little Tree-frog's activity throughout the greater part of the year, both by day and by night, it is perhaps not surprising that there is so little information concerning its retreats during cold spells or during other periods of inactivity. The following is apparently my only note on this topic. On May 12, 1930, near Suwanee Lake, an individual had sought a diurnal retreat beneath a log in a dried-up cypress pond; it was very richly colored (deep brown).

Structure and Locomotion

A curious and common habit of this frog is to turn its head and neck to one side, and even to rotate them slightly on the longitudinal axis (Fig. 3), to an extent I have noted in no other frog. There is apparently some unusual flexibility in the anterior part of its vertebral column. This may be of special advantage to the frog in looking about for a landing-place for its next leap, while clinging to such a slender perch as a grass-stem. The position of its body as a whole on such a perch can not be shifted so readily as that of some larger tree-frog on the branch of a shrub or tree.

In keeping with its partly arboreal habitat, its digital disks (Fig. 4) are somewhat better developed, and its fourth toe is less attenuated, than those of most or all of the species of *Pseudacris* (which are terrestrial); in these respects it verges toward the several common species of *Hyla* of eastern North America.

The usually observed method of locomotion is by leaps. The tibia is large in proportion to the body (Fig. 4), and the frog is a very proficient leaper for its size. Once, in the pine barrens at Suwannee Lake, I saw one crawl along a saw-palmetto leaf, moving one leg at a time; by this method it covered a couple of inches or more.

Fig. 3. *Hyla ocularis*, adult. On a tupelo root in the creek swamp above Suwannee Lake, Ware County, Ga., April 24, 1932. (Note the slight rotation of the head on the longitudinal axis of the body.)

Fig. 4. *Hyla ocularis*, adult, 16 mm. in length (F. H. no. 143). Suwannee Lake, Ware County, Ga., April 24, 1932. (Note the comparatively robust development of the tibia; also the better development of the digital disks in this species than in most species of *Pseudacris.)*

Voice

This is one of the veriest insect-chirpers among American frogs. Just as a herpetologist, on first hearing the Bird-voiced Tree-frog *(Hyla avivoca)*, would almost surely pronounce it a bird, so would the same listener, when greeted for the first time by the chirps of the Little Tree-frog, all but inevitably dismiss them from his mind as something of no concern to him. He might even casually notice one of these little creatures leaping from one grass-stem to another, and think of it as nothing more than one of the tiniest of grasshoppers. Perhaps by some chance the chirpings arouse his curiosity, and he decides to follow them through the nocturnal darkness to their source. Then, with luck,

his electric torch may reveal one of these ridiculous little make-believe frogs perched crosswise on the branch of a shrub or on the trunk of a black-gum sapling, at frequent intervals puffing out its blueberry-sized vocal sac and shrilling its insect notes. Perhaps his sentiments on such an occasion will not be so very different from those of a seven-year-old who, on being shown a live specimen, protested, "Daddy, how *could* that be a frog?"

In keeping with its diminutive size, this species, among all our frogs, is one of the most indifferent to the presence of a human being. This trait considerably facilitates observations on its vocal and other habits.

The note is subject to a certain amount of variation, both in its form and in the rate of utterance. But it is constantly characterized by an insect-like shrillness and also by a certain ringing quality, suggestive of the tinkling together of hollow beads. It is audible up to a distance of 80 yards, and may be distinguished above the rumble of a fast train by a frog-conscious passenger. Its carrying power is in strange contrast to the insignificant volume of sound when heard close at hand. The commonly heard form of call is a rolling *ts-r-e-e-k;* but often there is a distinct break in the note, when it becomes *ts'r-e-e-k* or *s'lick*.

In uttering its chirp, the frog compresses its sides and simultaneously inflates its vocal sac, which swells to about three times the size of the head. The sac is so transparent that the bark of a tree may be distinguished through it. Between notes it is deflated to about half its maximum size, or less. When completely inflated, it does not extend quite to the tip of the lower jaw. In this slight character the affinity of the species seems to lie with *Hyla (avivoca, cinerea, femoralis,* and *versicolor)* rather than with *Acris* or *Pseudacris (feriarum, nigrita, ornata,* and *triseriata)*.

On January 11, 1936 (3:50 p.m., temp. about 67°), at a cypress pond 4 miles west of Folkston, one of these frogs uttered a series of about 13 simple, rapid calls—*ts-r-e-e-k*—followed by 2 or 3 of the broken, less rapid calls—*ts'r-e-e-k*. The entire series of about 16 calls was completed in 7 seconds. This series had just been preceded by a similar one, consisting of about 15 calls. On the afternoon of March 31, 1937 (about 65°), at Dedge Pond, Charlton County, an individual gave 8 calls in 10 seconds. During the evening of May 20, 1921 (about 70°), at a cypress pond on Billy's Island, the calls were given at the rate of 32 per minute. During the evening of May 26, 1921 (about 80°), at the same pond, the rate varied from 31 calls per minute with one frog to 44-47 per minute with another. On June 25, 1929 (about 9 p.m., 75°), at Suwannee Lake, I recorded about 8 calls in about 5 seconds. From these varying records it is obvious that no definite correlation can be established between the temperature and the rate of calling; in this respect *Hyla ocularis* differs from *Pseudacris ornata, P. nigrita nigrita,* and probably other members of that genus.

Vocal Season

Midget as it is, the Little Tree-frog has energy enough to prolong its vocal season to a greater length than that of any other frog I am familiar with. October and December are the only months for which I have no vocal record, and I have little doubt that eventually it will be heard in those months, too.

In Charlton County, Ga., in 1936, the first calls of the season were heard at two different cypress ponds about 4 miles west of Folkston on January 6 (at 2:30 p.m., temp. about 80°, and during the evening, temp. about 68°). Others were heard at cypress ponds in the same area on January 9 at 11:36 a.m. (about 64°); on January 11 at 3:50 p.m. (about 67°); and on January 15 at 3:45 p.m. (about 64°). From one to several individuals were involved in each of the above-mentioned records. There seemed to be no large or general choruses in January. The temperatures at the time of calling ranged from about 64° to 80°.

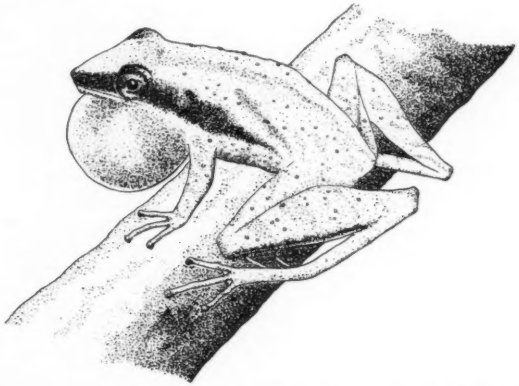

Fig. 5. *Hyla ocularis*, chirping male (x3.5). (Drawn by R. Oldt Pawling.)

Vocal activity was noticed at Dedge Pond, 2 miles east of Chesser's Island, on February 14 at noon (about 70°); near Starling Branch on February 16 at 7 p.m. (about 57°); near Folkston on February 17 at 8 and 10:30 p.m. (about 59° and 54°); and 4 miles west of Folkston on February 15 at 5:30 p.m. (about 61°), on February 24 at 7:20 p.m. (about 60°), and on February 26 at 7 p.m. (about 68°). Evidently larger numbers were in voice in February than in January. Fair choruses were heard on the 16th, 17th, 24th, and 26th. The temperatures at the time of calling during this month ranged from about 54° to 70°.

During the next month vocal activity was noted more frequently than in January and February: March 3, 8, 28, 30, and 31, Chesser's Island (at tem-

peratures ranging from about 62° to 73°); March 4, 5, 7, 11, and 27, at several cypress ponds near Spanish Creek and Long Branch (at temperatures ranging from about 65° to 75°); March 5, border of Spanish Creek swamp (about 9 p.m., about 63°); March 10, 4 miles north of Folkston (11:50 a.m., about 60°). In Liberty County: March 22, near Walthourville (8:20 p.m., about 60°); March 24, near Riceboro (8-8:35 p.m., about 68°).

During a brief trip in 1937 I heard the species near Riceboro, Liberty County, on March 27 (7:10 p.m., about 52°); also at Chesser's Island, Okefinokee Swamp, and vicinity, on March 29, 30, and 31 (at temperatures ranging from about 51° to 68°).

In considering these records for the comparatively cool months of January, February, and March, it is perhaps noteworthy that the majority of them were secured during the daylight hours; further, that there are comparatively few records at temperatures below 60°, and none below 50°. On the other hand, Holbrook's Chorus Frog *(Pseudacris ornata)* and the Spring Peeper *(Hyla crucifera)*, which were maintaining vocal activity during these same months in 1936, called regularly at somewhat lower temperatures than the present species, and occasionally at decidedly lower temperatures (down to 27° in the case of *P. ornata* and 32° in the case of *H. crucifera*) (*cf.* Harper, 1937, p. 266). *Hyla ocularis* is obviously not such a hardy species as the other two in the matter of resisting low temperature. Perhaps it is more venturesome than the other two species in the matter of diurnal activity because its diminutive size and its insignificant voice do not expose it so readily to predatory creatures.

During April, 1936, in Charlton County, the voice was noted on Chesser's Island on the 1st, 2nd, 6th, 9th, and 10th, at temperatures ranging from about 70° to 82°; and at cypress ponds west of Spanish Creek on April 5 (about 60°). It was noted in Camden County, near Greenville, on April 15 (about 4:45 p.m., about 84°); in Toombs County, near Lyons, on April 24 (7:25 p.m.); in Ware County, 6 miles north of the Satilla River, on April 25 (11:15 a.m.), and at Suwannee Lake on the same day (about 3 p.m. and 8:24 p.m., 64°). At Chesser's Island, the notes were heard on May 2 (8 p.m., 71°).

In several previous years (between 1921 and 1931) I have heard the Little Tree-frog calling quite commonly in the Okefinokee region during May, June, July, and August. The temperatures at the time of calling ranged from about 70° to 93° in May; from about 68° to 87° in June; from about 70° to 87° in July; from about 70° to 79° in August. The latest vigorous choruses were heard on August 20 and September 17, 1922. On the latter date, after hard rain the previous evening, the species was calling on Chesser's Island as well as near Folkston and at several places between Waycross and Jesup. In the fall of 1935 a silent individual was seen at Chesser's Island on October 26, and several others on the border of Spanish Creek swamp on November 3. During the forenoon of November 9 (about 65°) and again during the afternoon of November 11 (about 78°) a single individual was heard calling on Floyd's Island Prairie; these were the latest vocal records of the season. In view of the resumption of vocal activity in early January, there is doubtless

no real hibernation in the Okefinokee region—nothing more than possible suspension of activity during cold spells of a few days' duration.

During the cooler part of the year, vocal activity in this species seems to be governed more by temperature than by rainfall or humidity; but during the warmer months the converse seems to hold.

Measurements

The sexing of preserved specimens by external characters seems to present greater difficulties in this species than in any member of the genus *Pseudacris*. Breeding males of *Pseudacris*, when preserved, exhibit either an inflated throat or tell-tale folds on a collapsed throat. But in the case of males of *H. ocularis*, these folds are generally very inconspicuous or possibly absent altogether. There seems to be no pronounced or constant sexual difference in the color of the throat, as in the species of *Pseudacris*. Size is a criterion of limited usefulness; any specimen with a length of more than 16 mm. and a tibia of more than 9 mm. is probably a female. The proportional measurements are apparently almost identical in each sex.

Perhaps one of the most feasible means of having correctly sexed specimens available for study—aside from dissection, with its undesirable mutilation—would be to collect singing males and mated pairs.

Eleven specimens from southern Georgia, probably about equally divided as to sex, exhibit the following extreme and average measurements: length, 11-18 mm. (14.5); tibia, 7-9.5 (7.9); whole hind foot, 9-13 (11.1); elbow to tip of third finger, 5-7.5 (6.3); interolecranal extent (distance between elbows when humeri are extended in the same line at right angles to longitudinal axis of body), 7-10 (8.7); intergenual extent (distance between knees when femora are extended in the same line at right angles to longitudinal axis of body), 11-15.5 (13.4).

Cope's statement (1889, p. 348) that "the tibia is longer than in any of the genus [*Pseudacris*]" is, of course, the exact opposite of the truth. He doubtless meant that it is proportionately longer (in relation to the length of head and body); this holds in comparison with some, but scarcely all, of the species of *Pseudacris*.

Erroneous statements in regard to the length of this species have crept into the literature here and there: up to 10 "lignes" [22.5 mm] (Daudin, 1802, p. 33); "11 lines" [23.3 mm.] (Holbrook, 1838, ed. 1, vol. 3, p. 79); "1 inch or less" (Dickerson, 1906, p. 162); "25 mm." (Nieden, 1923, p. 352; "25 mm." (Pratt, 1923, p. 179, and 1935, p. 168). Perhaps the more modern of these errors go back to Copes two columns of measurements (1889, p. 348), one of which gives the actual measurements, the other the proportional measurements. The figure for length in the column of proportional measurements is "1.00."

The largest specimen among the eleven whose measurements are given in the third paragraph above is perhaps the largest on record for Georgia; it has a length of 18 mm. and a tibia of 9.5 mm. It was taken on March 31, 1937,

by Arthur Cope Emlen, Jr., at Dedge Pond, Charlton County. In North Carolina, according to Brandt (1937, p. 218), the species reaches "a length of 19 mm. or less."

In a tiny species like the present one, with a breeding season apparently extending over more than half the year, any attempt at dividing adult specimens into age groups or year-classes on the basis of size is beset with practically insurmountable difficulties.

Generic Allocation

The present species seems to have a less attenuated fourth toe, more distinct digital disks, and a slightly greater expanse of interdigital webbing than most or all of the species of *Pseudacris*. It appears to differ from all species of that genus (at least all those whose vocal habits are better known), in that its inflated vocal sac does not extend quite to the tip of the lower jaw. There are also divergences in behavior from *Pseudacris*: it differs from all members of that genus in being partly arboreal; it maintains no contact with the water during its vocal performance; there is apparently no definite correlation between its rate of calling and the temperature. In respect to its habitat (chiefly grass), it occupies a more or less intermediate position between terrestrial *Pseudacris* and arboreal *Hyla*.

However, in at least most of the characters of external structure as well as of behavior, the species evidently has closer affinities with *Hyla* than with *Pseudacris*.[2] Accordingly, after all the nomenclatural vicissitudes that the species has experienced, I return to the original designation, *Hyla ocularis* Bosc and Daudin.

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Notes on the Food Habits of Certain Maryland Lizards

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In connection with a study of the reptilia of the state of Maryland, I have had occasion to examine the stomach contents of individuals of five of the six species of lizards known to occur in that state, i.e., *Sceloporus undulatus undulatus* (Latreille), *Cnemidophorus sexlineatus* (Linné), *Leiolopisma unicolor* (Harlan), *Eumeces fasciatus* (Linné), and *E. laticeps* (Schneider). All but a few specimens were taken by myself and are in my collection.

The most efficacious method of collecting, particularly for stomach work was by shooting with dust shot, using a .22 calibre rifle. Other specimens were taken by noosing or caught with the hand. The contents of the entire alimentary tract were examined in every case, the word "stomach" being used arbitrarily in this paper. It has been observed that these lizards can not readily digest chitin so that evidence found even in the cloaca is frequently useful. Empty stomachs are not recorded. Specimens found in the stomach contents were not determined beyond family or order and frequently even this was extremely difficult or impossible. I have been assisted in certain identifications by Mr. Harvey Scudder of Cornell University.

Sceloporus undulatus undulatus (Latreille)

The contents of 40 stomachs of this species were examined. Four classes of invertebrates were represented: *Hexapoda, Arachnida, Diplopoda,* and *Gasteropoda.* Of these the *Hexapoda* greatly predominated, insects having been found in every stomach. Orders and families, as far as could be determined are as follows:

Hexapoda: Hymenoptera—38, *Formicidae*—37, *Ichneumonidae*—4, *Andrenidae*—1, *Chrysididae*—1, *Mutillidae*—1, unidentified—13; *Coleoptera*—35, *Scarabaeidae*—13, *Rhynchophora*—8, *Chrysomelidae*—7, *Carabidae*—5, *Buprestidae*—3, *Cerambycidae*—3, *Elateridae*—2, *Cleridae*—1, *Erotylidae*—1, *Ostomatidae*—1, *Tenebrionidae*—1, *Cicindelidae* (one leg)—1, unidentified—21; *Lepidoptera*—23, larvae—15, adults—10; *Orthoptera*—11, *Gryllidae*—4, *Acrididae*—3, *Tettigoniidae*—2, *Acrydiidae*—1, *Blattidae*—1, unidentified—2; *Hemiptera*—9, *Pentatomidae*—4, *Reduviidae*—3, *Aradidae*—1, unidentified—5; *Diptera*—8; *Mecoptera*—1; *Odonata*—1.

Arachnida: Araneida—18; *Pseudoscorpionida*—1.
Diplopoda—1.
Gasteropoda: Pulmonata—2.

In respect to the above, certain remarks must be made. Although *Hymenoptera* were found in all but two stomachs, and in individual stomachs were frequently the most numerous insects, it can not be said that they form the bulk of food because of their small size. *Lepidoptera* larvae and *Orthoptera* (grasshoppers) on the other hand frequently may occupy the greatest space

in individual stomachs. Generally speaking, it appears that *S. u. undulatus* will eat any insect or spider it can catch and master. Except for size no limitations are apparent. The examination of the alimentary tract itself indicates, as a list of data can not, that medium-sized and small insects are preferred. Insects are seldom found large enough to have taxed the lizard's swallowing capacity. On the other hand, a stomach and intestine will frequently be stuffed with innumerable ants, small beetles, tiny spiders, and other diminutive forms and their remains. By actual examination rather than by a list of species found, one is convinced of the voracious appetite of this lizard. For sheer numbers of insects that frequently appear in a single stomach at one time, it is unique among the five species here considered.

Cnemidophorus sexlineatus (Linné)

The stomach contents of 10 specimens of this form were examined. Although spiders are eaten, insects form the principal item of diet as follows:

Hexapoda: Orthoptera—6, *Acrididae*—4, *Tettigoniidae*—1, undetermined grasshoppers —2; *Hymenoptera*—4, *Formicidae*—2, undetermined—2; *Lepidoptera*—4, larvae —3, adults—1; *Hemiptera*—2; *Coleoptera*—2, larvae—1.

Arachnida: Araneida—3.

But little can be said from the evidence above of the general food habits of this lizard. When found, *Orthoptera* and *Lepidoptera* larvae formed the bulk of food. In other stomachs other large insects were substituted. This lizard appears to be rather disdainful of small prey.

Leiolopisma unicolor (Harlan)

Only one stomach examined contained food. Two orders were represented: *Orthoptera* by a cricket and *Lepidoptera* by a small moth. Obviously few conclusions can be drawn from such scant evidence. The size of the above mentioned organisms was large in proportion to the lizard.

Eumeces fasciatus (Linné)

The evidence concerning the food of the common skink is derived from the examination of the contents of the alimentary tracts of 25 individuals. In addition to invertebrate remains there is evidence of cannibalism or at least partial cannibalism. In the stomach of one specimen was found the severed tail of a skink apparently approximating it in size. Coincidently this specimen had freshly lost its tail, hence it is not beyond the realm of possibility that it may have devoured its own broken appendage. In the intestine of another, numerous *Eumeces* scales were found of sufficient diversity of size and shape to indicate that it had fed upon another individual of its own species or *laticeps*. Both specimens were half grown juveniles.

The invertebrate classes represented were: *Hexapoda, Arachnida, Crustacea,* and *Gasteropoda.* Of these, the insects were predominantly represented. In the order of their frequency, orders and included families appear as follows:

Hexapoda: Orthoptera—11, *Gryllidae*—2, *Acrididae*—1, *Acrydiidae*—1, *Blattidae*—1, undetermined grasshoppers—3, undetermined—4; *Coleoptera*—10, *Rhynchophora*—1, *Cerambycidae*—1, *Elateridae*—adult—1, larva—1, *Staphylinidae*—larva—1, *Carabidae*—1, undetermined—7; *Diptera*—5; *Lepidoptera*—adult—1, larva—1; *Hymenoptera*—1, *Formicidae*—1; *Odonata* (dragonfly)—1; *Thysanura*—1; undetermined insects—3.

Arachnida: Araneida—8.
Malacostroca: Isopoda—1.
Gasteropoda: Pulmonata—5.

From the evidence it appears that *Orthoptera, Coleoptera,* and *Araneida* form the bulk of food of *E. fasciatus,* but that it is likely to feed upon any arthropod of suitable size that it encounters. It apparently prefers prey of relatively large size, frequently rejecting smaller creatures as evidenced by its apparent lack of interest in ants and other small insects. That it is extremely swift and agile in pursuit of its prey is shown by the appearance of *Diptera* and *Odonata* in its food. The taste for snails is of interest in that four of the five individuals containing them were juveniles. This is evidence, though obviously poor, that the juveniles frequent the ground, rotting logs, and stumps more than the adults.

Eumeces laticeps (Schneider)

Unfortunately only two stomachs of this interesting lizard were available. One contained representatives of *Orthoptera, Hymenoptera,* and *Araneida.* The other contained a small *E. fasciatus.* Certain remarks are pertinent to the latter case. The *laticeps,* a juvenile, was sent to me by a collector who placed in the box with it 2 smaller specimens of *E. fasciatus.* When the package arrived only 1 of the latter was found. The evidence is strong, though circumstantial, that one of the *fasciatus* was devoured in transit.

Certain additional facts are worthy of note. In the alimentary tracts of all the species examined and of most of the specimens, I have observed the appearance with notable regularity of foreign matter of various sorts. Bits of leaves, blades of grass, tiny twigs, plant stems, sand, gravel, and stones of surprising dimensions are frequently found. This indicates first of all a characteristic impetuosity of attack, with a corresponding lack of discrimination once food is taken into the mouth. It indicates further that feeding for the most part occurs on or near the ground. I have observed this in the field with *S. u. undulatus, C. sexlineatus,* juvenile *E. fasciatus* and adult *E. laticeps,* while it is unlikely that *Leiolopisma* feeds anywhere else.

Certain differences can be seen, however. That young *E. fasciatus* frequent damp areas under boards, or under bark is indicated by the presence in their diet of snails, a wood boring larva, and a sow bug. The presence of adult *Lepidoptera,* consisting except in one instance of moths, implies habits of continual searching of the surface of logs, the crevices in bark and among fallen leaves as is the case with *C. sexlineatus* and especially *S. u. undulatus.* Since the race runner frequents open sandy beaches and glades, it is not surprising

that the grasshoppers so commonly found in such places take a very prominent part in its diet.

Frequently when any creature is known to destroy insects much is said in its glorification as a benefactor to man. In the light of my own observations and experience, I am reluctant to claim for these lizards, at best, more than a slightly above neutral economic value from the human standpoint in Maryland. Only in isolated instances will they be found where their feedings will benefit man and his crops. *Cnemidophorus sexlineatus* is an example of this as it will sometimes acclimate itself to life in fields. Even it, however, retreats quickly before advancing civilization. In general these lizards feed upon native insects of no economic importance. If they do take species harmful to the forests, the benefit as likely as not will be nullified by attacks upon the predatory insects and spiders. In the economy of nature they do play a vital part, and their presence is unquestionably important to the everchanging "balance."

In conclusion, it may be said that these lizards within certain limits are practically omnivorous, but that they appear to have certain preferences. Whether these preferences are the result of habitat, or the habitat the result of preference it is impractical to attempt to say.

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Miocene Porpoise (Delphinodon dividum) from Southern Maryland

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The fossil porpoise described in this article resembles, in most of the essential structural details, the specimen of *Delphinodon dividum** exhibited at the United States National Museum. It was removed during August, 1937, by the writer and Mr. John H. Dante, from the Miocene deposits of the cliffs bordering the western shore of Chesapeake Bay about one half mile south of the mouth of Parker Creek. Subsequently, it was mounted and placed on display in the Museum of Geology at The Catholic University of America. The precise stratigraphic location of this specimen was Zone 12 of the Miocene (Calvert) deposits of Maryland, where it was found embedded in the gray sandy marl (bluish when wet) containing *Ecphora quadricostata* and *Cytherea staminea.*

The specimen consists of a skull, a portion of the right mandible, the atlas, one cervical, six dorsal and two lumbar vertebrae; a portion of the sternum, and parts of four ribs. The skull, although fairly complete when found, had been fractured before removal by the pressure of the overlying sediments. This resulted in part from the tidal undercutting of the face of this portion of the cliff.

The Skull.—The dorsal surface consists mainly of the maxillaries and the medially overlapping premaxillaries. The lachrymals are well preserved and the antorbital notches moderately deep. Because of extensive necessary restoration, only a portion of the suture with the frontals can be traced. The parietal and supraoccipital regions, due to their extreme thinness, were badly crushed. It was found, however, that the thickened medial portion of the supra-occipital was sufficiently preserved to give a fairly accurate idea of the height of the skull when placed in proper orientation with what remained of the right squamosal and parietal. The zygomatic process is about one-third as deep as long as stated by True in his description of *Delphinodon dividum.* The rostrum, measuring from the antorbital notches, is 21 cm long, or about one centimeter more than the distance from the same point to the occipital condyles. Since the rostrum measures 9 cm. between the antorbital notches, the porpoise may be termed a short-beaked type. The brain-case is large, broad, and almost equal in length to the rostrum. Taking these facts into consideration the skull, as restored, gives the following dimensions which are believed to be reasonably accurate:

* True, Frederick W. 1912—Description of a New Fossil Porpoise of the Genus *Delphinodon* from the Miocene Formation of Maryland; Jo. Acad. Nat. Sci., Phila. n.s. **15**:163-194, pl. 17-26.

Length of skull (Occipital condyles to extremity of rostrum)	41 cm.
Width of skull (across lachrymals)	16 cm.
Greatest width of skull (Between post-orbital projections of the supra orbital processes)	19 cm.
Greatest height of skull (post-occipital process to top of the nasals	13 cm.
Height from floor of foramen magnum to suture of frontals with supra-occipital	9.5 cm.
Length of rostrum (from antorbital notches)	21 cm.

Teeth.—Both the upper and lower jaws possess single-rooted homodont teeth situated in round cavities that average 4 mm. in diameter. There are about twenty-five such alveoli on each maxillary, and, judging from the fragment of the right ramus that was preserved, about the same number on the lower jaw.[1] The mandibular fragment is 22 cm. long, slightly arcuate, and averages a centimeter in width. It retained five teeth from the central portion of the jaw. The total length of the fourth of this series (front to back) is 22 mm., of which 6 mm. is crown. The crown is covered with black enamel, bluntly conical, and is corroded on the inner surface. Where the crown met the gum there is a slight constriction (a reduction from 4 to 3 mm.) followed by a flare to 5 mm., and then a gradual tapering of the root for the remaining 16 mm. to a blunt point that is slightly twisted. The embedded root of the hindermost of these five teeth is slightly bifurcated. This description agrees with that given for *Delphinodon* in which the teeth are said to average 29 mm. in length with a maximum diameter of 5 mm. for the largest teeth and 20 mm. in length with a maximum diameter of 4 mm. for the smallest.

Vertebrae.—The atlas, a cervical, six dorsals, and two lumbars are preserved. All of the vertebrae bear well ankylosed epiphyses apparently indicating a mature individual. The dorsals appear to be distributed as follows: 3rd, 4th, 5th, 7th, 9th, and 10th; judging from the sizes and shapes portrayed by True for *Delphinodon*. The last dorsal is immediately followed by the first lumbar and then there is a gap between this and the other, more posterior lumbar.

The atlas has a maximum width of 10 cm. at the zygapophyses, and an over-all height of 6.0 cm. The length is 2.8 cm. The upper transverse processes are small bladelike crests arising from the postero-superior margin. The neural arch is low and narrows in the vicinity of the neural spine latter which is hardly more than a mere nubbin. The greatest length of the atlas is in the vicinity of the zygapophyses where it measures 2.5 cm. In this area there are collar-like, anteriorly pointing, projections that form receptacles which accommodate the occipital condyles.

The preserved cervical lacks a neural arch which makes it impossible to determine which cervical it is. The inferior transverse processes of the zygapophyses are directed downward and outward as described for the type specimen of *Delphinodon dividum* by True. This cervical is a washer-like vertebra whose centrum is 3.2 cm. wide, 2.7 cm. high, and only 0.5 cm. long (thick).

[1] True gives the dental formula of *Delphinodon dividum* as $\frac{26 - 26}{27 - 27}$ which is probably the same as that above when allowance is made for restoration of maxillaries.

3rd Dorsal: The centrum is nearly twice as wide as long (2.9 cm x 1.8 cm.). The neural spine is slender and pointed. The neural cavity is 2.8 cm. wide by 2.3 high and remains practically constant in the next two dorsals described below. The maximum width at the diapophyses is 9.2 cm. These latter are sturdy and bear a semi-lunar facet for the articulation of the tuberculum of the rib.

4th Dorsal: Compared to the third dorsal, the centrum is longer (2.3 cm.) and the neural spine is higher. The neural arch is approximately of the same dimensions as the above.

5th Dorsal: Again, the proportions of the neural arch remain about the same but the neural spine is still higher and stouter. In width and height the centrum remains substantially the same but is still longer than the fourth (3.0 cm.) being thus nearly twice the length of the third dorsal. The distance between the extremities of the diapophyses is less than in the previously described dorsals being only 7.3 cm.

?7th Dorsal: As this dorsal consists only of the neural spine and those portions of the neural arch down to, and including, the diapophyses, it is difficult to give its precise position. The size of its spine, however, would indicate a gap between it and the dorsal vertebra last described, so it is provisionally described as the seventh.

9th Dorsal: The transverse processes (parapophyses) are short, the distance between their extremities being 8.8 cm. They bear a large facet for a single-headed rib. The centrum is 4.0 cm. long; 2.9 cm. wide; and 2.8 cm. high. The neural cavity is almost circular with a diameter of about 2.0 cm. The metapophyses are only preserved on the left side. They are bluntly triangular and directed obliquely upward.

10th Dorsal: This is larger in every respect than the ninth dorsal. Its centrum is 4.5 cm. long and the extreme distances between the ends of the parapophyses is 10.9 cm. There is a large facet for a single-headed rib on each extremity which faces directly outwards. The neural spines on the ninth and tenth dorsals are both broken but their bases indicate that they were similar in shape and size.

The centra of the lumbars are characteristically longer than those of the dorsals. The transverse processes are long and platelike and bear no ribs. There is a tendency for these to be developed a little anterior to the middle of the centra. Lastly, the neural cavities become progressively smaller and more pear-shaped as they are located posteriorly.

1st Lumbar: This is definitely in direct sequence with the last dorsal. Its centrum is 5.0 cm. long; 3.6 cm. wide; and 2.8 cm. high. The platelike transverse processes are 2.5 cm. wide and about 5.0 cm. long. The distance between their extremities, as restored, is 14.0 cm. The neural cavity is pear-shaped with the narrow part pointing upwards. The widest portion, toward the floor of the cavity, is 1.5 cm.; the height is 2.3 cm. The neural spine above the

zygapophyses is broken so its shape can only be inferred from other closely related types. It undoubtedly terminated distally in a squarish, untapered end. The metapophyses are preserved. They are bluntly triangular as in the posterior dorsals.

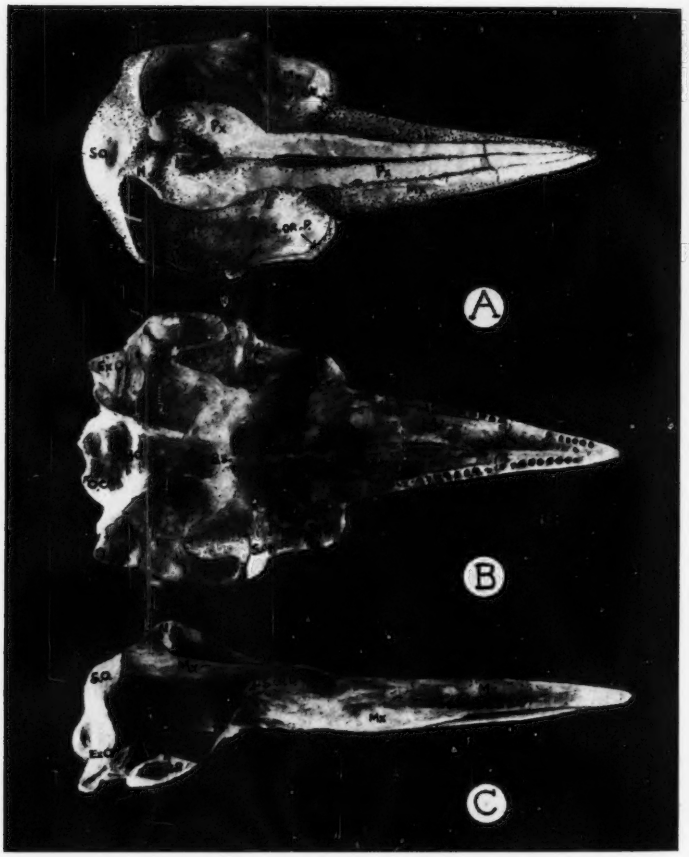
? Lumbar: The position of this lumbar is not definitely known but its size and shape infers a gap between it and the one described above. Its centrum is longer (5.7 cm.) than that of the first lumbar. It is also wider (3.8 cm.) and higher (3.4 cm.). The transverse processes are wide (2.8 cm.) and bladelike and measure about 14.5 cm. between extremities. The neural cavity is much smaller than that of the first lumbar and more acuminate. Its greatest width, at the base, is only 1.2 cm. but it is 2.8 cm. high. The neural spine is broadly spatulate and much more completely preserved than in the above described lumbar. None of the caudals are preserved. A comparison of the dimensions of the several vertebrae is given below.

DIMENSIONS OF VERTEBRAE
(in Centimeters)

Position of Vertebra	Height of Centrum	Width of Centrum Anterior-posterior	Length of Centrum	Max. Width Between Ends Transv. Processes
3rd Dorsal	2.3	2.9 - 3.7	1.8	9.2
4th Dorsal	2.5	2.9 - 3.6	2.3	8.3
5th Dorsal	2.5	3.0 - 3.6	3.0	7.3
7th Dorsal	----	----------	----	10.0 (?)
9th Dorsal	2.8	2.9 - 3.1	4.0	8.8
10th Dorsal	2.8	3.1 - 3.3	4.5	10.9
1st Lumbar	2.8	3.6 - 3.6	5.0	14.0
? Lumbar	3.4	3.8 - 3.8	5.7	14.5

Ribs.—None of the ribs is sufficiently complete to warrant description. The most representative fragment is arcuate, with a chord length of 18 cm. and possesses a curvature that closely approximates an arc of a circle of about 12 cm radius. Both the tubercular and capitular region of the proximal end are preserved. The width averages about 1.5 cm.; the thickness is less than 0.5 cm. There is a distinct sinus toward the articular end between the capitular and tubercular margins.

Sternum.—A piece of ossified sternum was found. It measures, roughly, 8.0 cm. by 13.0 cm. In general form it is basinlike and bifurcates at one end (anterior?) into branches 4.0 cm. long which taper from 3.0 cm. to 1.0 cm. in width. These rami are roughly triangular in cross-section and are bluntly rounded distally. The opening between them is deeply concave to form a symmetrical crotch. At the base of these branches, on the upper concave surface, there is a large shallow facet for the articulation of a rib. These facets are roughly circular and approximately 1.0 cm. in diameter. They face obliquely outwards. The greatest width of the sternum (8.0 cm.) lies along the line connecting these facets. Anterior to this line lies the crotch referred to above while behind it, over a distance of 6.0 cm., it gradually tapers from



Retouched photographs of skull of *Delphinodon Dividum:* A. Top view; B. Bottom view; C. Lateral view. x1/5.

AON, Antorbital notch; BO, Basi-occipital; BS, Basi-sphenoid; Ex.O., Exoccipital process; Me, Mesethmoid; Mx, Maxillary; N, Nasal; OC, occipital condyle; Pa, Parietal; Px, Pre-maxillary; SO, Supra-occipital; S.Or.P., Supra-orbital process of frontal (main portion of the frontal is telescoped beneath the maxillary); Z.P., Zygomatic process of the squamosal. (As the sutures in many cases are indefinite or have been obliterated, many of these areas are difficult to limit in the figures, and often this has not even been attempted.)

8.0 to 7.0 cms. in width. In this last region occur another set of facets for the articulation of ribs. These are about the same size but much deeper than those referred to above. Posterior to the line connecting these facets the sternum is abruptly broken. The fracture thus formed, while preventing further description, gives a good idea of the thickness of the sternum at this point. The thickest portion of the bone here exposed measures 0.7 cm. and lies near to the axis of symmetry of the structure. From this point it tapers to nothing marginally at a distance of about 2.5 cm. away.

A comparison of the dimensions of the various parts of the fossil herein described with those given by True for the type specimen shows that they average about 10% greater in most every respect. This would indicate that the specimen at The Catholic University of America was larger and more mature than the type specimen. The validity of such an assumption is borne out in several other ways. For example, the epiphyses are strongly ankylosed to the vertebrae, not losely as in the type specimen. Lastly, the skull sutures also seem tighter. From the above description, therefore, the writer deems that the fossil porpoise referred to can be properly labelled *Delphinodon dividum* True.

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A Taxonomic Study of the Genus Amelanchier in Minnesota*

Etlar L. Nielsen**

Anyone faced with the problem of identifying the forms of *Amelanchier* occurring in the upper Mississippi River basin by means of the manuals and floras purporting to cover the region soon meets with discouragement. This is not surprising in view of the inherent variability and complexity of the genus and the fact that no comprehensive systematic treatment of the group has been undertaken for this region. In default of any such treatment and because of inadequate material, the authors of the various manuals and floras have perforce had to rely on the reports of local workers which have been both meager as well as untrustworthy.

Prior to 1912, no extensive study of the genus *Amelanchier* had been undertaken. In Europe several (1, 6, 11, 22, 23) comprehensive systematic works had appeared in which the species of this genus were treated. These treatises, more of the nature of compilations of scattered material than original investigations, clearly showed the very unsatisfactory taxonomic status of the genus.

The earlier American work was reviewed by Wiegand (25) in 1914. In this paper, dealing with the species common to eastern North America, several new species were recognized and described and much of the confusing synonomy which had accumulated was clarified. This, and a second paper by the same author (26) dealing with additional eastern North American species, mark a distinct advance in the attack on the taxonomy of *Amelanchier* in that they are based to a large extent upon field study and the utilization of characters whose importance in species differentiation had not heretofore been appreciated.

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** The writer is indebted to Dr. K. M. Wiegand, Cornell University, for his suggestions, criticisms, and for those descriptions republished in this manuscript; to Dr. F. K. Butters, University of Minnesota, for his council, and aid with the Latin diagnoses; and particularly to Dr. C. O. Rosendahl, University of Minnesota, under whose supervision this work was done, for his constant interest, helpful criticisms and careful guidance throughout the course of this study and especially in the preparation of the manuscript. The writer also acknowledges the service of those persons who accompanied and aided him in carrying on the field studies herein reported. Acknowledgement is also due the authorities responsible for study facilities and loan of specimens from the Herbarium of Cornell University, the Gray Herbarium, the Herbarium of the Arnold Arboretum, and the Herbarium of North Dakota State College.

Research Paper No. 628 Journal Series, University of Arkansas.

Subsequent to Wiegand's second contribution, several manuals and floras have appeared in which the descriptions of those species established by him have been republished with very little alteration. The only significant deviations found in Britton and Brown's Illustrated Flora, 2nd. edition, were that *A. humilis* Wiegand and *A. stolonifera* Wiegand were regarded as synonyms of *A. spicata* Koch and that *A. alnifolia* Nuttall was again reestablished as a distinct species from the plains and mountains of western United States. Three of the species given in Rydberg's (20) Flora of the Prairies and Plains are very doubtfully distinct from *A. alnifolia.*

That widely divergent viewpoints still prevail in the interpretation of the species of *Amelanchier* is illustrated by Farwell's treatment (8). The present writer fails to see any justification for the changes proposed and feels that the conclusions reached by Wiegand in his obviously more exhaustive studies are thoroughly well founded. The points at issue will be discussed in the appropriate places in the systematic section of this paper.

In the present study only those representatives of the genus occurring in Minnesota and eastern Great Plains are considered. Here the genus offers many intricate problems that could not be solved in the time available for this study. There are indications that some of these will yield to more intensive field observation and the study of extensive herbarium material, while the solution of others may have to await the results of breeding experiments and cytogenetic investigations. The writer has drawn freely upon Wiegand's descriptions and interpretations of such species as are of relatively infrequent occurrence in Minnesota and of which, as a consequence, only limited Minnesota material is available.

Material and Method

When this study was begun the genus was represented in the Herbarium of the University of Minnesota, as is the case in many other herbaria, by a considerable number of flowering specimens and a few sheets showing abnormal leaf characters. It was therefore necessary to undertake extensive field-work and make detailed observations and collections from typical and atypical plants growing in as many different environments and localities as practicable. The data, taken at the time and place of collection, include information concerning the habit as well as the habitat of the plant concerned.

An inspection of the descriptions to follow will show that in the main the diagnostic characters used and found to be reliable are those that have previously been employed by other systematists. However, brief mention should be made of certain characters heretofore not included in species description and of certain additional factors that can not be obtained from herbarium specimens.

It was found that the mature dormant buds often possess diagnostic features; the size, shape, and color of the bud; the presence or absence of pubescence; the surface texture and the nature of the margin of the scales;

and the prominence of the veins of the middle scales often constitute reliable characters.

Considerable variation must be expected between specimens of the same species because of ecological factors. Plants growing under a forest canopy are often distinctly different from those grown under more xeric conditions. The former have leaves that are thinner, lighter in color, and not infrequently larger.

Plants bearing peculiar foliage have been carefully examined in the field to ascertain whether they were not traceable to previous injury. Severe cutting and breaking of shoots may cause the development of foliage which is often not recognized as closely related to that found upon an adjacent uninjured member of the same clone.

Hybridization

The field observation and herbarium studies have essentially duplicated the findings reported by Wiegand (25, 27) in which the importance of fire, grazing, and farming are considered as factors influencing the freedom of crossing of species of *Amelanchier, Aster, Crataegus,* and *Rubus*. Numerous localities visited definitely support this statement. One disturbed area near the boundary line of Itasca State Park, Clearwater County, has been logged, subsequently burned and is now covered with a dense thicket of shrubs, mainly *Amelanchier*. On these few acres an idefinite number of intermediate forms between *A. humilis* var. *compacta,* and *A. laevis* exist. Another such area is located on the outskirts of Carlton, Carlton County, near Duluth. The entire area was subjected to the devastating Moose Lake fire of 1918. In this situation a natural nursery of *A. humilis, A. huronensis,* and *A. laevis* was encountered. In addition to typical plants of these species, there is also a complete series of *A. humilis-laevis* and *A. huronensis-laevis* hybrids.

These cases illustrate the apparent ease with which species of the genus cross. Many others have been encountered and they explain why so many baffling collections have found their way into herbaria to constitute a perpetual problem to systematists. Unfortunately, the time required to make the necessary crosses and bring the successive generations to maturity is so long that it is not feasible to wait for the completion of hybridization experiments. The detailed studies in the localities mentioned and other less extensive observations made elsewhere lead one to believe that many of the doubtful and difficult specimens found in the other parts of the state may also be of the F_1 and F_2 or later generations. Rather than propose new names for these variants, which might possibly be grouped in a considerable number of artificial categories, the writer has felt it advisable merely to indicate the probably parentage of the specimen. Some of the intermediate types here considered as hybrids may eventually prove to be describable forms but until cytologic and genetic studies have been applied rather extensively to the group, it seems advisable to treat these as of hybrid origin.

KEY TO THE SPECIES OF AMELANCHIER IN MINNESOTA*

A: Flowers racemose; leaves conduplicate in bud, rounded or abruptly narrowed at the base; ovary summit rounded.
  I: Leaves entire or with a few teeth near the tip.
    a: Leaves mucronate; narrowly to broadly ovate; buds ellipsoid. ..... 6:** *A. mucronata*
    b: Leaves not mucronate; elliptic to oblong; buds ovate. ..... 4: *A. humilis*
  II: Leaves toothed, at least the upper third.
    a: Teeth coarse; main lateral veins conspicuous, parallel, mostly without intermediary veins.
      1: Leaves broadly acute or obtuse at the apex.
        m: Hypanthium saucer-shaped; plants mostly solitary or fastigiate.
          o: Main lateral veins running straight to the apex of the serrations (at least in the upper third of the leaf); hypanthium 4-5 mm. in diameter; petals linear or narrowly spatulate; buds dull. ..... 2: *A. sanguinea*
          p: Main lateral veins curving upward, often forking near the margin, the branches running into the teeth; hypanthium 5-7.5 mm. in diameter; petals obovate; buds vernicose. ..... 3: *A. huronensis*
        n: Hypanthium shallowly cup-shaped; plants stoloniferous and forming colonies.
          o: Leaves typically oblong or broadly oblong, sometimes ovate; apex acute or obtuse; mostly of forested areas. ....4: *A. humilis*
          p: Leaves typically orbicular or quadrangular; apex mostly rounded; mostly of prairie regions. ..... 1: *A. alnifolia*
      2: Leaves mostly truncate at the apex. ..... 1: *A. alnifolia*
    b: Teeth fine; main lateral veins not prominent, mostly forking irregularly near the margin, usually with short intermediary veins.
      1: Leaves truncate, round or obtuse at the apex; low stoloniferous shrub.
        m: Leaves elliptical - oval, oblong - oval (rarely orbicular); apex rounded or obtuse, mucronate; of forested areas.....5: *A. stolonifera*
        n: Leaves orbicular or quadrangular, apex truncate, not mucronate; of prairie regions. ..... 1: *A. alnifolia* var. *dakotensis*
      2: Leaves acute or acuminate; not a stoloniferous shrub.
        m: Leaves tomentose at the time of unfolding; green at flowering time.

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* The following interpretations of some of the terms used in the key should be considered: Leaves that have 5 or less serrations per cm. are considered as coarsely serrate and those with 6 or more as finely serrate. The hypanthium of the flower is called cup-shaped when its depth is about half its diameter and saucer-shaped when its depth is about one-fourth of its diameter.

Because of the close similarity in the general appearance of the leaves of certain species, particularly *A. humilis* and *A. alnifolia*, these will appear in more than one place in the key. In such cases it is necessary to note the combination of more detailed characters.

Another fact should be considered in attempting the determination of *Amelanchier*. Many of the specimens encountered will be hybrids and, as a consequence, will not readily key out to any of the species or varieties described in this paper. In most instances the specimen will probably key to the parent with which it has the greatest similarity.

** The species are numbered and arranged in sequence showing their probable natural relationship.

o: Leaves typically elliptic or elliptic-obovate; apex acute; sepals ascending or irregularly revolute. .....9: *A. intermedia*

p: Leaves typically ovate to oblong; apex mostly acuminate; sepals reflexed from the base.

r: Hypanthium broadly cup-shaped or saucer-shaped, 4-5 mm. in diameter; ovary summit woolly; leaves short acuminate.

t: Leaves carinate; margins sharply serrate with acute sinuses between the teeth. .....7: *A. Wiegandii*

u: Leaves flat; margins sharply serrate with rounded sinuses between the teeth. .....10: *A. interior*

s: Hypanthium deeply cup-shaped, 3-3.5 mm. in diameter; ovary summit glabrous; leaves acute or long acuminate. .....8: *A. canadensis*

n: Leaves glabrous at unfolding or with a few silky hairs; mostly bronze-purple at flowering time. .....11: *A. laevis*

B: Flowers commonly solitary (1-3 together), not racemose; leaves imbricate in the bud; mostly cuneate at the base; ovary summit conical.....12: *A. Bartramiana*

1. *Amelanchier alnifolia* Nuttall, Journ. Phil. Acad. 7:22. 1834.

Pyrus sanguinea Pursh, Fl. Bor. Am. **1**:34. 1814. (in part?)
Aronia alnifolia Nuttall, Genera. 306. 1818.
Amelanchier ovalis var. *semiintergrifolia* Hooker, Fl. Bor. Am. **1**:202. 1840. (?)
A. canadensis var. *alnifolia* T. & G., Fl. N. A. **1**:473. 1840.
not "*A. canadensis* var. *alnifolia* T. & G." Farwell, Rpt. Mich. Acad. Sc. 174. 1915.
not "*A. florida* Lindley," Wiegand, Rhodora **14**:143. 1912.
A. macrocarpa Lunell, Am. Mid. Nat. **3**:143. 1913.
A. leptodendron Lunell, Am. Mid. Nat. **5**:237. 1918.
A. Carrii Rydberg, Britton**ia** **1**:89. 1931.

A stoloniferous shrub commonly 1-3 (occasionally 7) m. high. Young twigs silky pubescent, becoming glabrate and reddish brown and often grayish with age. Terminal buds elliptic 7-8 mm. long; lateral buds 5-7 mm. long; dull chestnut brown (Rouge 35)*; long silky hairs emerging from below the margins of the upper scales; scales sometimes with upper half slightly puberulent, with gray membranous or corticeous tip, below merging into rather indistinct brownish margin, lowermost portion of the scale smooth. Leaves, mostly unfolded at flowering time, the greenish-yellow tomentum early deciduous, usually glabrate with age, occasionally a few hairs on the lowermost portion of the midrib and petiole, blades broadly elliptic to quadrangular, 2-3.5 x 2-3.5 (5) cm.; apex rounded or truncate (rarely subacute); base mostly rounded (rarely tapering or subcordate); margin serrate mostly above the middle, 2-5 (8) teeth per cm.; sinuses of the teeth acute; veins prominent, 8-10 (13) on each side of the midrib, curving upward, often forking, and each veinlet entering a tooth; petiole (1) 1.5-2.5 cm. long. Racemes erect, dense, few flowered, 1.5-3 cm. long at flowering time; axis silky pubescent, glabrate with age; lowermost pedicel 5-11 mm. long; petals obovate to spatulate (5) 6-7.5 mm. long; sepals (2) 2.5 x 2.5 (3) mm., triangular, becoming revolute with age; hypanthium (3) 3.5-4 mm. in diameter, shallowly cup-

* The colors referred to in the description of the buds are those appearing in the "Code des Couleurs" by Klincksieck and Valette. (10)

shaped; disc generally deeply lobed; ovary summit woolly. Fruits globose to obpyriform, 8-11 mm. in diameter, purplish when ripe, very sweet and juicy.

Blossoms about May 15; fruits mature in July. Along forest margins and on river banks, Minnesota to Nebraska and westward to the foothills of the Rocky Mountains, northward on the Canadian plains. In Minnesota limited to the western plains portion of the state.

In an earlier paper the writer (16) referred to *Amelanchier alnifolia* as one of the several densely pubescent forms of service-berries commonly found in the Great Plains region. This species, though generally included, has been poorly delimited in various manuals and floras for that region. Unfortunately the type specimen has not been located, but the circumstantial evidence which has been gathered and the field observations which have been made in the region traversed by Nuttall indicate that the species just defined is the same as the one described by the author.

All excepting one of the specimens of this species bearing Nuttall's label, which the writer has either studied or received information concerning, can be eliminated from type consideration either because they are from localities not visited by Nuttall before the appearance of the *Genera* or because they are flowering specimens. It is unlikely that Nuttall saw plants of this species in the flowering condition prior to the publication of the description for had he done so, he would presumably have included some floral characters. The exception just mentioned is an undated specimen of a sterile shoot now deposited in the British Museum. The writer is indebted to Mr. J. E. Dandy, Assistant Keeper, for a photograph and critical notes concerning it. Three labels on the sheet contribute the following information: "Arctic regions (Dr. Richardson)," "*Aronia ovalis*, Arctic Am. (from Richardson) *A. alnifolia* Nut. Gen.," and "Herb. Thomas Nuttall." It is improbable that this sterile shoot is the type for it is not marked with an asterisk (*), a symbol Nuttall usually used to designate his type specimens. Likewise, the photograph and the notes supplied by Mr. Dandy are not substantiative. The obovate-elliptic leaf-blade outlines, the long slender petioles, and the comparative colors of the upper and lower leaf surfaces are not typical of the form commonly found in the Great Plains.

Nuttall perhaps collected the material upon which *A. alnifolia* is based on his first trip into the Great Plains in 1811 when he followed the Missouri River from St. Louis, Missouri, to a locality somewhere above Fort Mandan (about fifty miles above the present city of Mandan, North Dakota) from whence he returned before the onset of winter the same year. An account of the trip to and about Fort Mandan is found in Bradbury's Travels (3). It is unlikely that the type specimen was collected on the journey to Fort Mandan since plants of the species being considered would not be in a stage sufficiently advanced so Nuttall could point out the "very saccharine fruits." The return to St. Louis was so late in the season that all fruits would have already disappeared. A study of the species description and of Bradbury's Travels, although not conclusive, leaves the impression that the type material was collected during the visit of Nuttall and his party while they were in the

proximity of Fort Mandan (June 22-July 17, 1811) where extensive collections were made from between the Little Missouri and Cannon Ball Rivers. Field observations and a critical examination of herbarium specimens from central North Dakota show that this is the period the fruits of *A. alnifolia* ripen. Furthermore, the critical characters of most specimens from that region agree in every respect with those mentioned by Nuttall in his original diagnosis. It is likewise significant that Fort Mandan is mentioned in the same description. The type material was apparently taken near Fort Mandan and the westward distribution of the species "to the Northern Andes" noted when Nuttall subsequently explored the upper reaches of the Missouri River in the company of Lisa (3).

The writer's field observations made in various localities in the region extending from the Platte River in Nebraska to the Turtle Mountains on the International Boundary and to the Badlands of North Dakota have shown that, excluding the Black Hills area, this is the most prevalent species of service-berry of that entire area.

From this evidence, the writer believes that the species just delimited is *Amelanchier alnifolia* Nuttall. Specimens taken from the region just indicated and determined by other botanists familiar with the flora of the Great Plains substantiate this conclusion. It is advisable, however, to state that it is unlikely that the species inhabits the extensive range frequently ascribed to it.

The types of Lunell's *A. macrocarpa* (14) and *A. leptodendron* (15) are now in the Herbarium of the University of Minnesota. Both of these species are here considered as inseparable from *A. alnifolia*. The type of *A. leptodendron* has, however, very abnormal foliage which readily is accounted for by the broken or injured ends of the terminal shoot.

An examination of some of the type material of *A. Carrii* Rydberg (19 which is also deposited in the Herbarium of the University of Minnesota, shows that it can be explained as an abnormal leafed specimen of *A. alnifolia* taken from a previously broken or injured shoot which has undergone some recovery.

In dealing with *A. alnifolia*, Farwell (8) reestablished the combination *A. canadensis* var. *alnifolia* made by Torrey and Gray (24) in 1840. This relationship cannot be substantiated since the morphological differences that separate *A. alnifolia* and *A. laevis** are those used to separate the coarsely serrated from the finely serrated leafed forms. The interpretation of *A. alnifolia* as a plant with ovate leaves is also at variance with Nuttall's description which states specifically "leaves roundish, the upper part toothed." Throughout the extensive field work that the writer has conducted on the Great Plains, no plants with ovate leaves that can be referred to this species have been encountered. A form with ovate leaves does occur on the Great Plains but other characters indicate that this was not the species Nuttall had in mind when he described *Aronia alnifolia*. The form considered by the writer as

* See pages 169 and 170.

typical *Amelanchier alnifolia* generally has broadly elliptical or roundish leaves and coarse serrations near the leaf tip. Rarely does it become of such size that it can be spoken of as possessing a bole, a character for this species first appearing in the description found in Sargent's *Silva* (20). It is very doubtful that *A. alnifolia* occurs in Michigan since it occurs only occasionally in the plains portion of western Minnesota where it rarely penetrates into the forested areas.

The material of *Amelanchier alnifolia* collected on the northern Great Plains can be separated into the following varieties and forms:

A: Leaf blades large, 2.5-3.5 (5) cm. in diameter; margin serrate-dentate, hypanthium 3.5-4 mm. diameter.
1: Fruits blue ..... var. *typica*
2: Fruits white ..... forma *alba*
B: Leaf blades small, 2-2.5 cm. in diameter; margin serrate, 5-8 teeth per cm.; lower surface somewhat glaucous; petioles 1 cm. long; hypanthium 3-3.5 mm. diameter. ..... var. *dakotensis*

Amelanchier alnifolia var. *typica* Schneider, Laubholzkunde 2: 738. 1906.
(as to name but probably not as to plant.)

Leaf blades elliptic or nearly orbicular, 2.5-3.5 x 2-3.5 (5) cm.; not glaucous below, apex rounded or truncate (rarely subacute); base mostly rounded (rarely tapering or subcordate); margin serrate-dentate mostly above the middle, 2-5 teeth cm.; petiole 1.5-2.5 cm. long; racemes 1.5-3 cm. long at the flowering time; lowermost pedicels 5-11 mm. long; petals 7-7.5 mm. long; hypanthium 3.5-4 mm. in diameter. (See Plates 1 and 16, Map 1)

A. alnifolia forma **alba** f. nov.

A var. *typica* fructibus albis differt.—Fruits white.

This variant has been observed and collected near Barie, N. D. where it had previously been seen and reported to the writer by Dr. A. D. Stoesz. Subsequently the writer has had reports of the occurrence of white-fruited plants from other localities in North Dakota, Montana, and Manitoba. All of these reports received to date have been from plains areas and probably concern this same form. The nearness of the type locality to the Minnesota state line makes it very likely that plants of this form also occur in this state.

Specimens of *A. alnifolia* var. *typica* examined:*

MINNESOTA: *Becker Co.:* Detroit Lakes, 1932. *E.L.N.* no. 1390, 1392. Height of Land Lake, 1935. *O.F.Z.* no. 280, 284, 286. *Chippewa Co.:* Montevideo, 1913. *Moyer*

* The abbreviations used in the citation of specimens are those of the following individuals: J. B. Moyle, N. C. Nielsen, C. O. Rosendahl, A. D. Stoesz, O. F. Zech, W. J. Breckenridge, F. K. Butters, F. Egler, N. L. Huff, A. and E. Mattioli, and those of the writer. In most instances where the writer has been one of the collectors, his numbers have been used. The specimens collected with J. B. Moyle in the fall of 1934 are indicated by placing the letter "M" before his collection number to distinguish them from those of the writer. Unless otherwise indicated all of the cited specimens are in the Herbarium of the University of Minnesota.

no. 346. *Ottertail Co.:* Pelican Rapids, 1932. *F.K.B.* no. 1342; Pelican Rapids, 1932. *E.L.N.* no. 1394, 1395.

NEBRASKA:* Custer Co.: Gorge north of Sargent, 1935. E.L.N. no 3409; *Boyd Co.:* Panca River near Lynch, 1935. *E.L.N.* no. 3512; Missouri River bluffs opposite Greenwood, S. D., 1935. *E.L.N.* no. 3513, 3514, 3516; Lynch, 1935. *E.L.N.* no. 3515. *Holt Co.:* Niobrara River south of O'Neil, 1935. *E.L.N.* no. 3435, 3436. *Garfield Co.:* Burwell, 1935. *E.L.N.* no. 3410.

NORTH DAKOTA: *Barnes Co.:* Near dump, Valley City, 1933. *E.L.N.* no. 2138. *Benson Co.:* Berwick, 1919. *Lunell;* Butte, 1907. *Lunell;* Pleasant Lake, May 21, 1912 and July 28, 1911. *Lunell* (Type of *A. macrocarpa*). *Bottineau Co.:* Lake Metigoshe, Turtle Mountains, 1931. *E.L.N.* no. 1225, 1227, 1228, 1229. *Cass Co.:* Kindred, 1935. *A.D.S. Ramsey Co.:* Devils Lake, 1913. *Lunell. Rolette Co.:* Ravine of Willow Creek, Dunseith, May 15 and Sept. 3, 1918. *Lunell* (Type of *A. leptodendron*). *Stutzman Co.:* Spiritwood Lake, 1933. *E.L.N.* no. 2121, 2168, 2183, 2323. *Ward Co.:* Minot. 1929. *Lakela* no. 66.

SOUTH DAKOTA: *Berts Co.:* Bluffs of Big Stone Lake, 1911. *Moyer. Pennington Co.:* West of Rapid City. 1934. *Leedy. Lawrence Co.:* Deadwood. 1913. *Carr* no. 75 (part of type collection of *A. Carrii*). *Todd Co.:* Ironwood Creek Gulch, Rosebud, 1935. *E.L.N.* no. 3522, 3523, 3524, 3551; Little White River Valley, Rosebud, 1935. *Tolstead* no. 4-177, 4-188; Near Rosebud. *Tolstead* no. 4-290.

WYOMING: *Converse Co.:* Glenrock. 1937. *J. Eckorth* and *R. P. Daugherty.*

Specimens of *A. alnifolia* forma *alba* examined:

NORTH DAKOTA: *Nelson Co.:* Stump Lake. 1937. *O. A. Stevens* and *H. Graves. Richland Co.:* Sheyenne River Valley, Barie, 1934. *A.D.S.:* also 1935, *A.D.S.*, also July 27, 1934 and May 25, 1935. *A.D.S.* and *E.L.N.* no. 2796 (Type in Herb. of Univ. of Minn.)

A. alnifolia var. **dakotenis** var. nov.

"*A. alnifolia* Nutt." Lunell, Am. Mid. Nat. **3**:144. 1913.

Laminis foliorum minoribus, 2-2.5 cm. diam. serratis dentibus 5-8 per cm., subtus glaucis; petiolis 1 cm. longis; hypanthio 3-3.5 mm. diam.

Leaf blades orbicular or quadrangular, 2-2.5 x 2-2.5 cm.; somewhat glaucous below, apex mostly truncate; base rounded or subcordate; margin sharply serrate 5-8 teeth per cm.; petiole 1 cm. long. Racemes about 2.5 cm. long at flowering time; lowermost pedicel 8-9 mm. long; petals 5-6 mm. long; hypanthium 3-3.5 mm. in diameter.

The only specimens known are those cited from central and southeastern North Dakota. (See Plate 2-A)

Specimens of *A. alnifolia* var. *dakotensis* examined:

NORTH DAKOTA: *Barnes Co.:* City dump, Valley City, 1933. *E.L.N.* no. 2140. *Benson Co.:* Butte, 1910. *Lunell. Richland Co.:* Sheyenne River Valley, Barie. July 27, 1934 and May 25, 1935. *A.D.S.* and *E.L.N.* no. 2801. (Type in Herb. of Univ. of Minn.); also 1934. *A.D.S.* and *E.L.N.* no. 2800-II.

2. *Amelanchier sanguinea* (Pursh) DC. Prodromus **2**:633. 1825.**

Mespilus canadensis var. *rotundifolia* Michx. Fl. Bor. Am. **1**:291. 1803 (in part?).
Pyrus sanguinea Pursh, Fl. Am. Sept., 340. 1814. (in part?).
Aronia sanguinea (Pursh) Nuttall, Genera 306. 1818.
"*A. spicata* (Lam.) Koch." Rob. & Fern., Gray's Man. ed. **7**:460. 1908.

* Out of state specimens are cited for those species and varieties which are either described as new or more critically delimited in this paper.

** For more complete synonymy see Wiegand (25).

Straggling or arching shrub 1-3 m. high, the stems solitary or a few in a clump. Young twigs generally bright reddish-brown. Buds narrowly ovate, acute; terminal buds about 7 mm. long, lateral buds about 6 mm. long; reddish-brown (Rouge 35), dull; margins of scales light brown, with short puberulence or moderately short silky hairs exserted from below the margins of the bud scales, the middle scales often with a few external hairs, the lower scale somewhat 3-toothed at the apex. Leaves unfolding at the time of flowering; green above when young, rarely purplish; at first densely pale flavescent- tomentose below, becoming glabrate or with a few persistent traces of tomentum along the midrib and petiole; blades oval to oval-oblong, rarely orbicular, 2.5-4 x 3-6 cm.; apex subacute or rounded; base rounded or subcordate; margin coarsely dentate-serrate nearly or quite to the base, teeth sharp and spreading 4-5 (6) teeth per cm., sinuses generally open; veins rather close together, straight, conspicuous, the upper veins running straight to the margin and entering the teeth, about 10-13 main lateral veins on each side of the midrib; petioles slender, 12-22 mm. long. Racemes loose, soon nodding, many-flowered, 4-7 cm. long, axis pubescent but soon glabrate; lowermost pedicel 10-20 mm. long; petals linear to narrow spatulate, 11-15 mm. long, connivent at full anthesis; sepals ovate-lanceolate, acute, 4 mm. long, revolute with age, woolly above at flowering, soon glabrate; anthers 0.6 mm. long; hypanthium 4-5 mm. in diameter, saucer-shaped, glabrous on the outside and spreading after the petals fall; ovary summit densely woolly. Fruit globose, conspicuously constricted above, black and very sweet at maturity.

Blossoms about the middle of May in southeastern Minnesota, and about a month later in the northeastern corner of the state. Fruits ripen in July and August. Quebec to Ontario and Minnesota and south along the mountains to northern Alabama. In Minnesota this species is limited to the extreme southeast and northeast corners of the state. (See Plates 3 and 16, Map 2)

In 1783 Lamarck (12) described *Crataegus spicata* from garden material reputed to have been introduced from eastern North America. This specific name has been variously applied to several species of service-berry including *A. sanguinea*. Those who have seen the type of *A. spicata* and are thoroughly familiar with the species of *Amelanchier* in eastern North America are disposed to regard it as a constant form hybrid of *A. oblongifolia* x *A. stolonifera*. Farwell (8) stressed the importance of Lamarck's species in connection with the discussion of plants which recently have been passing as *A. sanguinea*. He emphasized the importance of K. Koch's (11) work and stated ". . . . these trees are what have later been known as *A. sanguinea* D. C. Furthermore, that the description of Lamarck fits these trees in all particulars. The evidence seems to be conclusive." A study of Koch's discussion is less assuring since he (11) concludes his remarks with the following statement "Die Lamarckische Beschreibung passt allerdings nicht genau auf unsere Pflanze." Farwell considered this species as *A. canadensis* var. *rotundifolia* and erroneously applied this name to the arborescent form with glabrous, finely serrated leaves previously described by Wiegand (25) as *A. laevis*. The relationship assumed by Farwell is hardly true because *A. sanguinea* has coarse leaf serrations,

prominent parallel veins, a saucer-shaped hypanthium when in flower, and a fruit which is conspicuously constricted above. In comparison, the serrations of *A. laevis* are fine, the veins less prominent and somewhat irregular especially near the leaf margin, the hypanthium is campanulate in flower, and the fruit not sharply constricted above. Differences of this nature and magnitude have been found to be of specific instead of varietal rank in *Amelanchier*.

A comparison of the specimens of *A. sanguinea* collected in Minnesota has been made with a considerable number of typical eastern specimens in the Herbarium of Cornell University. This examination shows that the material from west of western Pennsylvania and New York is slightly different from that occurring farther east. The following variations appear to separate the western form from the eastern: (1) the petals are shorter, wider, and more blunt and are spreading at full anthesis instead of connivent; (2) the leaves are generally folded and smaller at flowering time and are more sharply serrate; (3) the pubescence is somewhat grayish and appressed. More extensive field observation and the study of additional material of this western form is necessary to determine the significance to these variations.

Amelanchier sanguinea has been confused with *A. humilis* var. *compacta* from which it is differentiated by: (1) its longer and less compact racemes; (2) larger flowers with longer and acute sepals, longer and linear petals, and a larger hypanthium which is conspicuously constricted in fruit; and (3) its solitary or fastigiate habit. It has also been confused with *A. huronensis* which is recognized by: (1) its larger flowers which have very flat hypanthia that become very deep when the fruits are mature; (2) the obovate petals; and (3) its lateral leaf veins that curve upward and often fork near the margin of the blade.

Specimens of *A. sanguinea* examined:

MICHIGAN: *Isle Royale:* Tobins Harbor, 1912. *C.O.R.* no. 2657.

MINNESOTA: *Beltrami Co.:* Lake of the Woods, 1894. *MacMillan* and *Sheldon* no. 1747. *Cook Co.:* Devils Track River, 1879. *C. W. Wall;* Kimball Creek, Grand Marais, 1912. *C.O.R.* no. 2635; Island in Sea Gull Lake, 1932. *N.C.N.* and *E.L.N.* no. 1670. *Goodhue Co.:* Cannon Falls, 1882. *Sheldon. Houston Co.:* Winnebago Valley, 1899. *Wheeler* no. 203; Hokah, 1933. *C.O.R.* and *E.L.N.* no. 1835, 1837, 1838.

3. *A. huronensis* Wiegand, Rhodora 22:150. 1920.

Shrub or small tree 3-7 m. high. Buds ovate; terminal buds 7-8 mm. long; lateral buds 5-6 mm. long; dark purple or reddish-brown (Rouge 4, 5); mostly vernicose; a few silky hairs exserted from below the margins of the scales; margins sharply set off from the main body of the scale by their light brown color; lower scales shallowly 3-toothed at the apex. Leaves unfolded at flowering time; floccose-flavescent pubescent when young, soon glabrate or with a few scattered hairs; blade oblong, suborbicular, to sometimes obovate, 3.5-5.5 x 4-7 cm.; apex rounded to subacute; base rounded to subcordate; margin coarsely serrate-dentate to near the base, rarely less than below the middle, 3-4 teeth per cm.; veins prominent especially near the base, curving upward and often forking near the margin and the veinlets running into the serrations, about 12 main lateral veins on each side of the midrib; petiole slender

1.5-3 cm. long. Racemes loose, many-flowered, 4-7.5 cm. long, axis floccose-flavescent pubescent when young, glabrate or with a few hairs at maturity; lowermost pedicel 12-30 mm. long at flowering time; petals obovate to broadly oblanceolate, 12-18 mm. long; sepals acute, 2-2.5 x 3.5-5 mm., woolly above at flowering time, soon glabrate, becoming revolute from the middle after the petals fall; anthers 0.6-0.9 mm. long; hypanthium 5-7 mm in diameter, broadly saucer-shaped; ovary summit woolly. Fruits globose or slightly elongate, 5-8 mm. in diameter, dark purple and very sweet when ripe.

Blossoms in late May and early June; fruits mature in August near the Great Lakes. Along the Great Lakes from Ontario and Michigan to Wisconsin and Minnesota. In Minnesota it occurs on calcareous drift or on basic rock outcrops of the northern or northeastern portion of the state. (See Plates 4 and 16, Map 3).

The writer first collected this species on the banks of Bohall Lake, Itasca Park, in May, 1931. Since that time, more extensive field work throughout the north central and northeastern portion of the state has proved it to be very common especially along the north shore of Lake Superior where it occurs in the calcareous draws and crevices. Some of the material collected show the following variations that do not fall within the limits of the species as originally delimited by Wiegand: (1) the hypanthium is occasionally but 5 mm. in diameter; (2) the lowermost pedicel is sometimes 30 mm. long when the plant is in full flower; (3) occasionally the serrations do not extend entirely to the base of the leaf blade; (4) the leaves may be subglabrate at the time of full anthesis and show no trace of pubescence in later stages. Although these variations occur, the plants exhibiting them unquestionably belong to *A. huronensis*.

Specimens of *A. huronensis* examined:

MICHIGAN: *Isle Royale:* Rock Harbor, 1909. *W. S. Cooper* no. 125.

MINNESOTA: *Aitkin Co.:* McGregor, 1927. *C.O.R.* no. 5243, 5244. *Carlton Co.:* Carlton, 1935. *A.* and *E.M.* no. 21, 25, 29; Carlton, 1932. *E.L.N.* no. 1371, 1372, 1373, 1374; Suspension Bridge, Jay Cook Park, 1935. *W.J.B.* and *E.L.N.* no. 3188, 3189, 3192; *Cass Co.:* Walker, 1935. *E.L.N.* no. 3152, 3153. *Clearwater Co.:* Bohall Lake, Itasca Park. 1931. *E.L.N.* no. 1133. *Cook Co.:* Porcupine Island, Grand Portage, 1930. *C.O.R.* and *F.K.B.* no. 6258; Grand Portage, 1932. *F.K.B.* and *M. F. Buell* no. 370; Mt. Josephine, Grand Portage, 1932. *N.C.N.* and *E.L.N.* no. 1606, 1615, 1616; Wauswaugoning Bay, Pigeon Point, 1933. *F. E.* and *E.L.N.* no. 2022, 2024; Clark's Bay, Pigeon Point, 1933. *F.E.* and *E.L.N.* no. 2031, 2038, 2040A; Gunflint Lake, 1934. *F.K.B.;* Tofte, 1935. *W.J.B.* and *E.L.N.* no. 3225, 3228; Grand Portage, 1935. *W.J.B., J.W.M.* and *E.L.N.* no. 3226. *Lake Co.:* Illegen City, 1935. *W.J.B.* and *E.L.N.* no. 3164; Larimount. 1935. *W.J.B., J.W.M.,* and *E.L.N.* no. 3183. *St. Louis Co.:* Minnesota Point, 1936. *Lakela* no. 1339.

4. *Amelanchier humilis* Wiegand, Rhodora 14:141. 1912.

Amelanchier canadensis var. *oblongifolia* T. and G. Fl. N. A. **1**:473. 1840. (in part).
"*A. oblongifolia* (T. & G.) Roemer." Rob. & Fern. Gray's Man. ed. **7**:460. 1908; Bergman Fl. N. D. 255. 1912.

A rather stiff upright stoloniferous shrub occasionally over 5 m. high.

Buds ovate; terminal buds 7-9 mm. long; lateral buds 4-6 mm. long; scales chestnut brown or deep plum (Rouge 35, 40, 45), color of margins variable, dull or somewhat vernicose; hairs generally exserted from below the margins of the lower scales; lower scales 3-toothed; veins indistinct or invisible. Leaves unfolded or unfolding at flowering time, at first densely yellowish-white to grayish-green tomentose beneath, nearly glabrous above, at length glabrate or with some tomentum persistent on the petiole, blade oblong, elliptic, ovate, rarely obovate 2-4 x 2.5-5 cm.; apex mostly broadly subacute, sometimes rounded; base subcordate, rarely rounded or tapering; margin coarsely serrate-dentate to below the middle, occasionally nearly entire, 4-5 (6) teeth per cm., sinuses of teeth acute; 7-13 main lateral veins on each side of the midrib, slightly curving upward, forking before reaching the margin or remaining distinct and entering the teeth; mature petioles 1-2 cm. long. Racemes terminal and lateral, erect, 2-5 cm. long, pedicels and axis silky tomentose; lowermost pedicel, mostly 9-13 mm. long, about as long as or greatly exceeding the length of the subtending leaf petiole; petals obovate-oblong, 7-10 mm. long; sepals triangular, about as long as wide or 2 times as long as wide, revolute from the middle after the petals fall; hypanthium about 3 4 mm. in diameter, deeply saucer-shaped; ovary summit woolly. Fruits globose or slightly elongated, conspicuously constricted above at maturity, black, glaucous, sweet, and juicy when ripe.

Blossoms in early May; fruits ripen about July 1. Vermont and Ontario to New York, Ohio, and Minnesota. Also in the Black Hills. Common on limestones and dolomites in southern Minnesota, extending northwestward to Marshall County and northward to Aitkin County. Apparently, the typical form is characteristic of the deciduous forest and is replaced in the coniferous forest by var. *compacta* and on the plains by var. *compestris*.

Farwell (8) relegated *A. stolonifera* and *A. humilis* to synonomy under his new combination of *A. Botryapium* var. *micropetala*. In doing so he disregarded the characters Wiegand (25) had found sufficiently diagnostic to describe them as new species after their author was convinced that they were distinct from any previously described. These two species are clearly defined throughout their range and appear as clearcut and readily separable from their congeners in Minnesota as in New York and New England. In addition to being morphologically distinct they differ in their soil requirements, the former being a calciphobe and the latter a calciphile. This holds true for Minnesota as well as for the eastern part of their range and it seems improbable that these distinctions should break down only in limited portions of the area in which they occur.

In the same paper Farwell described, among others, a new variety of *Amelanchier* namely *A. Botryapium* var. *conferta*. This was based upon a double flowered individual of which only a single collection is cited. In view of the fact that floral proliferation is of frequent and fluctuating occurrence in the Rose family, it would appear that a sporadic occurrence of this kind could have been sufficiently taken care of by a passing mention only.

Amelanchier humilis constitutes a polymorphic group in Minnesota. Several distinct races exist but these grade nearly imperceptibly into each other. Using the leaf shape and margin and the inflorescence as a basis of study, the Minnesota material can be grouped in four rather well defined varieties. There are, however, a number of intermediate specimens that are very difficult to place. This is particularly true of varieties *typica* and *compacta* which are the two most common forms in the state. The Minnesota forms can be differentiated in the following manner:

A: Leaves typically oblong; sometimes ovate.
  1: Racemes generally 4-5 cm. long (occasionally shorter); flowers large, hypanthium 4-5 mm. in diameter. Leaves usually coarsely dentate-serrate above the middle, 4-5 teeth per cm., occasionally entire. Buds glabrous. Common in the deciduous forest. .....4a: var. *typica*
  2: Racemes 2.5-3 cm. long, flowers small, hypanthium 3-3.5 mm. in diameter. Leaves entire or with a few teeth near the apex, about 6 teeth per cm. Bud scales with prominent hairs on the outer surface. Known only from the Sioux quartsite outcrops in southwestern Minnesota. .....4d: var. *exserrata*

B: Leaves typically elliptic; sometimes ovate or obovate.
  1: Veins conspicuous and running into the coarse serrations. Racemes mostly 2-3.5 (5) cm. long, loose; hypanthium 3.5-4 mm. in diameter; sepals acute and somewhat longer than wide (about 3 mm. long). Typically of prairie regions. .....4c: var. *campestris*
  2: Veins generally forking and less prominent near the margin. Racemes mostly 2-2.5 (3) cm. long, very compact; hypanthium about 3 mm. in diameter; sepals blunt, about as long as wide (about 2-2.5 mm. long). Typically of forested regions. .....4b: var. *compacta*

4a. *Amelanchier humilis* var. *typica*.

Amelanchier humilis Wiegand sensu stricto.
"*A. humilis* Wiegand" Ros. and Butt. Tr. & Sh. Minn. 216. 1928 (in part).

A rather stiff upright stoloniferous shrub occasionally over 5 m. high. Buds generally ovate, mostly curved, long, somewhat vernicose. Leaves unfolding with flowers, at first densely yellowish-white tomentose beneath; blade typically oblong, sometimes ovate, 2-4 x 2.5-5 cm.; apex mostly broadly subacute, sometimes rounded; base subcordate or rounded, occasionally cuneate; margin coarsely serrate dentate to below the middle, occasionally nearly entire, 4-5 teeth per cm.; 9-13 main lateral veins on each side of the midrib, slightly curving upward and forking before reaching the margin. Racemes terminal and lateral, erect, loose, generally 4-5 cm. long. Lowermost pedicel mostly about 15 mm. long, generally greatly exceeding the length of the subtending leaf petiole; petals obovate-oblong, 7-10 mm. long; sepals triangular-lanceolate, generally about 2 times as long as wide (2 x 4 mm.), revolute from the middle after the petals fall; hypanthium about 4 mm. in diameter, deeply saucer-shaped. Fruits globose or slightly elongated, conspicuously constricted above at maturity, black, glaucous, sweet, and juicy when ripe.

Blossoms in early May; fruits ripen about July 1. Vermont and New York, Ohio to Ontario and Minnesota. Also in the Black Hills. Common in the deciduous forests of Minnesota. (See Plates 5 and 16., Map 4)

A. humilis var. *typica* agrees in every respect with Wiegand's original description of this species except in size of the plant. Some of those found in Minnesota are often 15 feet or more in height. In a recent discussion of this species, Wiegand informed the writer that large specimens had also been found growing as an understory shrub in forests of New York State.

Specimens of *A. humilis* var. *typica* examined:

MINNESOTA: *Aitkin Co.:* Big Sandy Lake, 1926. *C.O.R.* no. 4962. *Anoka Co.:* 1935. *E.L.N.* no. 2965. *Blue Earth Co.:* Minneopa Park, Mankato, 1935. *C.O.R., J.B.M.* and *E.L.N.* no. 2999. *Becker Co.:* Detroit Lakes, 1934. *O.F.Z.* no. 193, 218. *Cass Co.:* Gull Lake, 1893. Ballard. no. B1249. *Clearwater Co.:* La Salle Springs, 1935. *E.L.N.* no. 1918, 1930; Peace Pipe Springs, 1933. *E.L.N.* no. 1966, 1968, 1971. Two miles north of Iron Springs Bog, Itasca Park, 1935. *E.L.N.* no. 3126, 3130. *Dakota Co.:* Westscott. 1934. *E.L.N.* no. 2410. *Goodhue Co.:* Frontenac, 1883. *Sara Manning;* Wacouta Beach, Lake Pepin, Red Wing, 1932. *E.L.N.* no. 1005, 1006, 1343, 1349. *Hennepin Co.:* Spring Park, 1907. *W. M. Moore.* Robbinsdale. 1931. *E.L.N.* no. 1098, 1099, 1101; Minneapolis, 1935. *E.L.N.* no. 2946, 2947, 2948. *Houston Co.:* Spring Grove, 1902. *C.O.R.* no. 316; Hokah, 1933. *C.O.R.* and *E.L.N.* no. 1839. *Hubbard Co.:* 1933. *E.L.N.* no. 3102, 3103, 3104, 3107, 3108, 3112. *Marshall Co.:* Thief Lake, 1933. *G. Swanson. Mille Lacs Co.:* Milaca, 1934. *J.B.M.* and *E.L.N.* no. 2580. *Morrison Co.:* Cushing, 1933. *E.L.N.* no. 1888. *Ramsey Co.:* First turn above the Ft. Snelling bridge, in St. Paul. 1932. *E.L.N.* no. 1308, 1340, 1341. *Sherburne Co.:* Zimmerman, 1934. *J.B.M.* and *E.L.N.* no. 2571, 2572. *Wabasha Co.:* Brook Lodge, 1905. *T. S. Roberts. Washington Co.:* Afton, 1935. *E.L.N.* no. 3076, 3077.

4b. **Amelanchier humilis** var. **compacta** var. nov.

Laminis foliorum praesertim ellipticis, venis marginem versus furcatis prominulis; racemis 2-2.5 (3) cm. longis valde compactis; hypanthio circa 3 mm. diam., sepalis obtusis 2.0-2.5 mm. longis et aequilatis.

A stoloniferous shrub commonly 4-5 (occasionally 8) m. high. Buds ovate, straight; margins of scales of the terminal buds of the same texture and color as the main body of the scale, the scales of the lateral buds with a light brown margin; surfaces of the scales pubescent at least the upper ones; toothing of the lower scales often suppressed with the middle tooth tending to form an umbo-like structure. Leaves usually folded at flowering time, densely gray-yellow tomentose when young; blade typically elliptic, occasionally obovate or ovate, 3-3.5 x 4-5.5 cm.; apex rounded or obtuse; base rounded or subcordate; margin sharply serrate-dentate, about 5 teeth per cm.; main lateral veins 7-12 on each side of the midrib, usually becoming less prominent before entering the teeth. Racemes dense, erect, few-flowered (7-9) generally 2-2.5 (3) cm. long; lowermost pedicel 7-9 mm. long (generally about the length or shorter than the petiole of the subtending leaf); petals small, widest above the middle, 3-5 x 5.5 mm.; sepals bluntly deltoid, about as long as wide, 2-2.5 mm., usually hairy above only at flowering time; hypanthium 3 mm. in diameter, broadly cup-shaped or deeply saucer-shaped, the disc mostly limited to the bottom of the saucer. Fruits becoming conspicuously constricted above with age, globose or somewhat elongate, eventually nearly black, sweet, and juicy when ripe.

This is the most common variant of *A. humilis* in Minnesota. It blossoms early in May in the southeastern part of the state and about a month later in the northeast corner. Its fruits mature in July and early August. It commonly forms dense thickets on forest margins. In the shade it becomes a tall straggling and scattered stoloniferous shrub. It is frequent in the forested portion of the state but more typically developed in the coniferous belt. (See Plates 6 and 16, Map 5)

A. humilis var. *compacta* can be distinguished from the typical variety by its: (1) small flowers; (2) broadly cup-shaped or deeply saucer-shaped hypanthium in which the disc is limited to the bottom of the saucer; (3) sepals that are about as wide as long (2-2.5 mm.); (4) lowermost pedicels that seldom exceed the length of the subtending leaf petiole; (5) dense tomentum that is grayish-yellow in color; (6) leaves that are folded at the time of full anthesis, generally rounded at the apex when mature, and turn red before falling; and (7) straight, hairy buds.

In 1912 Wiegand (25) pointed out that *A. humilis* differs from *A. erecta*, a species that had recently been described by Blanchard (2). A critical study of some of the specimens collected and determined by Blanchard shows that his species is characterized by long racemes, flowers with large petals and sepals that are much longer than wide, and by a deep cup-shaped hypanthium. All of these characters sharply seperate it from the variety here proposed as *A. humilis* var. *compacta*.

Specimens of *A. humilis* var. *compacta* examined:

MINNESOTA: *Anoka Co.:* Ham Lake, 1931. *E.L.N.* no. 1034, 1090; Decodon Bog, 1934. *E.L.N.* no. 2411; Soderville, May 12, June 16, Oct. 13, 1935. *E.L.N.* no. 2967 (Type in Herb. of Univ. of Minn.), 2968, 2970. *Becker Co.:* Detroit Lakes, 1932. *E.L.N.* no. 1391; Detroit Lakes, 1934. *O.F.Z.* no. 158; Brandy Lake, 1934. *O.F.Z.* no. 198; Detroit Lakes, 1934. *O.F.Z.* no. 212, 218; Height of Land Lake, 1934. *O.F.Z., J.B.M.* and *E.L.N.* no. M1707; Indian Mounds, N. Detroit Lakes, 1935. *O.F.Z.* no. 261, 262; also Oak Lake, 1935. *O.F.Z.* no. 297, 298. Carlton Co.: Jay Cook Park, 1935. *A.* and *E.M.* no. 18; Cloquet, 1934. *C. Swanson.* (3 specimens.) *Cass Co.:* Gull Lake, 1893. *A. P. Anderson.* no. A440; Lake Kilpatrick, 1893. *Ballard.* no. B1442; Walker, 1932. *E.L.N.* no. 1160. *Chisago Co.:* Taylors Falls, 1916. *C.O.R.* and *F.K.B.* no. 3334. *Clearwater Co.:* The following numbers from Itasca State Park and immediate vicinity. Bohall Lake, 1931. *E.L.N.* no. 1134; LaSalle Springs, 1931. *E.L.N.* no. 1146, 1186, 1187, 1191; Peace Pipe Springs, 1933. *E.L.N.* 1970, 1972; Floating Bog Bay, 1933. *E.L.N.* no. 1899; *Cook Co.:* Grand Portage, 1935. *W.J.B.* and *E.L.N.* no. 3221, 3222. *Crow Wing Co.:* Deerwood, 1934. *J.B.M.* and *E.L.N.* no. 2635, 2637; Brainerd, 1934. *J.B.M.* and *E.L.N.* no. 2662, 2663. *Dakota Co.:* Wescott, 1934. E.L.N. no. 2406, 2409; Hastings, 1935. *C.O.R., C. E. Dutton* and *E.L.N.* no. 2951, 2952, 2953. *Fillmore Co.:* Rushford, 1933. *C.O.R.* and *E.L.N.* no. 1855; Mabel, 1933. *C.O.R.* and *E.L.N.* no 1856. *Goodhue Co.:* Belle Creek, Cannon River Valley, *C.O.R.* no. 5525; Barn Bluff, Red Wing, 1931. *E.L.N.* no. 1006, 1104, 1109; Welch, 1933. *E.L.N.* no. 1812. *Hennepin Co.:* Fort Snelling, 1910. *C.O.R.* no. 2433; St. Louis Park, 1931. *E.L.N.* no. 1093, 1096, 1097; Franklin Avenue Bridge, Minneapolis, 1935. *E.L.N.* no. 2962. *Houston Co.:* Spring Grove, 1926. *C.O.R.* no. 4933. *Hubbard Co.:* Lake George, 1928. *C.O.R.* no. 5699. *Lake Co.:* Encampment, 1893. *Sheldon.* no. 4770. *Mille Lacs Co.:* Mille

Lacs Lake, 1934. *J.B.M.* and *EL.N.* no. 2584, 2588. *Morrison Co.:* Little Falls, 1934. *J.B.M.* and *E.L.N.* no. 2666. *Olmstead Co.:* Rochester, 1934. *E.L.N.* no. 2402. *Ottertail Co.:* Big Pine Lake, 1912. *Bergman;* Pelican Rapids, 1932. *F.K.B.* no. 1342. *Ramsey Co.:* 1931. *E.L.N.* no. 1100B, 1101. *Rice Co.:* Northfield, 1931. *E.L.N.* no. 1103. *St. Louis Co.:* Ely, 1934. *J.B.M.* and *E.L.N.* no. M1943. *Sherburne Co.:* Zimmerman, 1934. *J.B.M.* and *E.L.N.* no. 2570, 2573. *Wabasha Co.:* Lake City, 1927. *C.O.R.* no. 5215. *Winona Co.:* Winona, 1901. *Holzinger.*

NORTH DAKOTA: *Cass Co.:* Woods north of Fargo, 1934. *A.D.S. Ransom Co.:* Sheyenne Sand Hills, 1934. *A.D.S.*

4c. **Amelanchier humilis** var. **campestris** var. nov.

Laminis foliorum praesertim ellipticis, venis conspicuis in dentes crassos percurrentibus; racemis 2-3.5 cm. longis laxis; hyanthio 3.5-4 mm. diam., sepalis acutis longioribus (3 mm.) quam latis.

Straggling stoloniferous shrub 2-3 m. high. Buds ovate; light brown; outer scale surfaces with a few long silky hairs. Leaves mostly unfolded at flowering time, gray-green pubescent, blades typically elliptic to elliptic-oblong, occasionally somewhat ovate or obovate, 2-4 x 3-6 cm.; margin coarsely serrate-dentate nearly to the base, about 5 teeth per cm.; apex rounded to subacute; base rounded or slightly subcordate; veins prominent and ascending, forking near the margin and the branches running into the serrations, main lateral veins 8-12 on each side of the midrib. Racemes erect, few-flowered, 2-3.5 (seldom 5) cm. long; lowermost pedicel 7-9 (seldom 5-15) mm. long; petals obovate to oblong-obovate, 7-8 (10) mm. long; sepals 2-3 mm. (generally about half again as long as wide), acute irregularly revolute in fruit; hypanthium 3.5-4 mm. in diameter, saucer-shaped (sometimes nearly becoming a flat disc at the time the petals fall), disc generally deeply lobed and often brown in color. Fruits globose, constricted above at maturity.

Blossoms about May 15; fruits ripen in early July. Common on stream and lake banks in southwestern Minnesota and eastern South Dakota. (See Plates 7 and 16, Map 6).

This new variety of *A. humilis* is distinguished by: (1) racemes intermediate in size between those of var. *typica* and var. *compacta,* and (2) leaves typically elliptic to elliptic-oblong, occasionally somewhat ovate to obovate in outline, with (3) very prominent veins that ascend and enter the sharp teeth that generally extend to near the base of the blade.

Specimens of *A. humilis* var. *campestris* examined:

MINNESOTA: *Chippewa Co.:* Montevideo, 1893. *Moyer. Cottonwood Co.:* Bean Lake, Stordan, 1935. *C.O.R., J.B.M.* and *E.L.N.* no. 2975. *Lac qui Parle Co.:* Carlton Lake, 1885. *Moyer. Lincoln Co.:* Lake Benton, 1891. Sheldon no. 1358; Stony Point, Dead Coon Lake, May 19, June 23, and Oct. 19, 1935. *C.O.R., J.B.M.* and *E.L.N.* no. 2979 (Type in Herb. of Univ. of Minn.). no. 2985, 2987, 3056, 3065, 3063. *Pipestone Co.:* Quarries, Pipestone, 1935. *C.O.R., J.B.M.* and *E.L.N.* no. 3009, 3071. *Redwood Co.:* Redwood Falls, 1891. *Sheldon.* no. S945. *Rock Co.:* Luverne, 1935. *C.O.R., J.B.M.* and *E.L.N.* no. 3072.

SOUTH DAKOTA: *Brookings Co.:* Warren's Woods near White, 1925. *J.W.M.* no. 1551, 1552, 1553, 1554, 1556.

4d. Amelanchier humilis var. **exserrata** var. nov.

Laminis foliorum praesertim oblongis ut in var. *typica*, integris vel dentibus paucis apicem versus instructis; squamis gemmae extime sericeis; racemis 2.5-3 cm. longis, floribus minoribus; hypanthio 4-5 mm. in diam.

A stoloniferous shrub 0.5-1 m. high. Twigs often with many short spurs. Buds ovate, acute; scales with prominent hairs on outer surface, margin of scales light brown; middle tooth of the lower scale prominent, early deciduous. Leaves unfolded at flowering time, yellowish-gray pubescent when young; blades typically oblong or elliptic-oblong, 2-2.5 x 5-6 cm.; apex rounded; base rounded or seldom cuneate; margin entire or with a few serrations near the apex, about 6 teeth per cm.; main lateral veins ascending and branching freely near the margin, 10-12 (occasionally 8) on each side of the midrib. Racemes erect, dense, few-flowered, 2.5-3 cm. long; lowermost pedicel 5-9 mm. long; petals linear spatulate or narrowly obovate, 9 mm. long; sepals triangular, 2.5-3 mm. long; hypanthium 3-3.5 mm. in diameter, deeply saucer-shaped; disc very well developed. Fruits globose, (known only from dried specimens seen late in autumn).

Blossoms about May 15. Known only from the outcrops of Sioux quartzite near Pipestone, Pipestone County in southwestern Minnesota. (See Plates 8 and 16, Map 7).

Four numbers of this variety have been collected from the Pipestone quarries in southwestern Minnesota where it grows in dense stoloniferous colonies. Its distinguishing features are: (1) the nearly entire oblong leaves; (2) the main lateral veins ascend and branch freely when about two-thirds of the distance out from the midrib; (3) the racemes are short, compact, and of small flowers; (4) the hypanthium disc in this variety is very well developed. In some instances it nearly fills the space between the wall of the hypanthium and the base of the style.

This variety requires additional field and laboratory observation to determine its exact systematic rank. It perhaps occurs on the outcrops of the Sioux quartzite south of Sandborn, Minnesota, as well as southward on the exposures of this formation near Garretson, S.D.

Specimens of *A. humilis* var. *exserrata* examined:

MINNESOTA: *Pipestone Co.:* Quarries, Pipestone, May 19 and Oct. 19, 1935. *C.O.R., J.B.M.* and *E.L.N.* no. 3070, 3015 (Type in Herb. of Univ. of Minn.); Quarries, Pipestone, 1935. *E.L.N.* no. 3676, 3677.

5. *Ammelanchier stolonifera* Wiegand, Rhodora 14: 144. 1912.*

A stiff upright shrub 0.5-1.5 m. high forming patches from stolons. Buds ovate-ellipsoid; terminal buds 6-7 mm. long, lateral buds 5-6 mm. long; dull

* For synonymy see Wiegand (25).

reddish-brown (Rouge 35); silky hairs sometimes exserted from below the margins of the scales; margins light brown, slightly wider at the tip; lower scales generally 3-toothed at the apex, the middle tooth somewhat larger. Leaves unfolding and about half grown at flowering time; green or sometimes bronze in color when young, nearly glabrous above, densely white tomentose beneath, soon glabrate or with a few hairs along the lower part of the midrib; blades elliptical-oval, or oblong-oval (rarely orbicular), 2-3.5 x 2.5-5 cm.; apex rounded or obtuse, mucronate; base rounded, rarely subcordate or cuneate; margin finely and sharply serrate above the lower third, 5-8 teeth per cm., sinuses between the teeth acute or rounded; main latral veins 8-9 (7-11) on each side of the midrib, usually curving upward and becoming indistinct near the margin; petioles slender, 1-2 cm. long, glabrate or with a few hairs at maturity. Racemes somewhat dense, erect 1.5-4 cm. long, pedicels and axis pubescent when young, becoming glabrate with age; lowermost pedicel 7-15 mm. long; petals oblong to obovate, 7-9 mm. long; sepals triangular-lanceolate, 2.5-3 mm. long, revolute from the middle with age; hypanthium 3-4 mm. in diameter, saucer-shaped; ovary summit woolly. Fruits globose or slightly elongate, constricted above, becoming black, juicy and sweet when ripe.

Blossoms about June 15; fruits ripen in late August. Dry rocks, gravel, or sand, in non-calcareous districts on the coastal plain in Newfoundland, and from Maine to Virginia. In scattered acid areas in Vermont, western Massachusetts, New York, Michigan, and Minnesota. Confined to acid rock outcrops and sandy areas in northeastern Minnesota. (See Plates 2B and 16, Map 6)

This low very stoloniferous species is confined to the northeastern corner of the state where it occurs on acid rock outcrops and sandy areas. It has been found abundant on the slopes above Clark's Bay near Pigeon Point, Cook County. Specimens in vegetative condition from Burntside Lake, near Ely, St. Louis County, appear to be of this species. The apparent absence of specimens from most of the Arrowhead Country is probably due to insufficient field work rather than the lack of plants of this species in that area.

The specimens from Minnesota generally have slightly more obtuse and more coarsely serrate leaves than specimens from New York and Pennsylvania. Collections from the type locality in Massachusetts and the Minnesota specimens are very similar in this respect.

Specimens of *A. stolonifera* examined:

MINNESOTA: *Cook Co.:* Naniboijou Club, 1935. *W.J.B.* and *E.L.N.* no. 3217; Clark's Bay, Grand Portage, 1935. *W.J.B.* and *E.L.N.* no. 3231A, 3232A, 3233, 3240. *Lake Co.:* Mouth of the Baptism River, 1935. *W.J.B.* and *E.L.N.* no. 3170, 3172; Beaver Bay, 1935. *W.J.B.* and *E.L.N.* no. 3177. *St. Louis Co.:* Burntside Lake, 1935. *W.J.B.* and *E.L.N.* no. 3206.

6. **Amelanchier mucronata** sp. nov.

Frutex humilis stoloniferus 1 m. altus. Gemmae ovato-ellipsoidales, terminales 6-7 mm. longae, laterales 5-6 mm. longae rubro-fuscae. Folia in anthesi olivacea, evoluta subglabrata; laminae late ovatae vel ellipticae 2.5-3.0 cm.

latae, 3.5-4.5 cm. longae, apice mucronatae basi rotundatae vel subcordatae, margine integrae vel apicem versus serratae dentibus paucis 4-5 per cm.; petioli 2-2.5 cm. longi. Racemi stricti densiusculi 3-5 cm. longi marcescentes axi sparse viridi-pubescentes mox glabratae. Petala 8-9 mm. longa, elliptica vel late obovata, sepala acuta triangula angusta 3.5-5.5 mm. longa in anthesi supra lanata in fructu glabrata; hypanthium acetabuliforme 4-5 mm. diam.; apex ovarii dense lanatus. Fructus globosus praeter apicem paullo contractus.

A low stoloniferous shrub 1 m. high. Buds ovate-ellipsoid; terminal buds 6-7 mm. long, lateral buds 5-6 mm. long; dull reddish-brown (Rouge 35); margins of scales light brown; silky hairs exserted from below the margins of the lower scales which are generally 3-toothed at the apex, the middle tooth somewhat larger. Leaves densely yellow-green pubescent when very young, olive-green in color, unfolded and nearly glabrate at fllowering time; blades broadly ovate, elliptic, or elliptic-obovate, 2.5-3 x 3.5-4 cm.; apex mucronate; base rounded or occasionally subcordate; margin entire or with a few serrations near the apex, 4-5 per cm.; sinuses acute or rounded; main lateral veins 9-11 (14) on each side of the midrib, ascending and branching freely near the margin; petiole slender, 2-2.5 cm. long. Racemes strict, rather dense, 3-5 cm. long, axis with a sparse yellow-green pubescence at flowering time, soon glabrate, dead peduncles and pedicels often held until late the next growing season; lowermost pedicel 10-14 mm. long; petals 8-9 mm. long, elliptic or broadly obovate; sepals acute, triangular 3.5-5.5 mm. long (about 2-2½ times as long as wide), woolly above at flowering time, glabrate in fruit; hypanthium 4-5 mm. in diameter, saucer-shaped; ovary summit densely woolly. Fruits globose, somewhat constricted above in young fruits. Size and quality at maturity unknown.

Blossoms about the middle of June; fruits ripen in late August. Known only from Clark's Bay, Cook County. (See Plates 6 and 16, Map 7)

Amelanchier mucronata is characterized by its stoloniferous habit and strict racemes. The floral structure, as well as bud characters, indicate close relationship to *A. stolonifera*. It differs from the latter in its broadly ovate to elliptic-ovate leaves which are entire or with a few serrations very near the mucronated apex. The serrated leaves of *A. stolonifera* are elliptic, oval, or rarely orbicular in outline. At flowering time the foliage of *A. stolonifera* (in Minnesota at least) possesses a bronze tone as compared to the olive-green color of the new species here proposed. Specimens of this species have been collected only on diabase or other strongly basic rock whereas *A. stolonifera* is a calciphobe. It is perhaps prevalent in the Canadian region along Lake Superior and northward.

Specimens of *A. mucronata* examined:

MINNESOTA: *Cook Co.:* Clark's Bay, Grand Portage, 1933. *F.E.* and *E.L.N.* no. 2036, 2042, 2043; also 1935. *W.J.B.* and *E.L.N.* no. 3234, 3239, 3242; also June 9 and Oct. 5, 1935. *W.J.B., J.W.M.* and *E.L.N.* no. 3230 (Type in the Herb. of Univ. of Minn.); also 1935, *J.W.M.* and *E.L.N.* no. 3664.

7. Amelanchier Wiegandii sp. nov.

Frutex arcuatus 3-5 (8) m. altus. Folia juvenalia tomentosa, in anthesi glabrata evoluta ferruginea; laminae plerumque oblongae carinatae apice brevissime acuminatae basi rotundatae vel subcordatae marginibus fere ad basin acute serratis dentibus (4-5 per cm.) ac sinubus acutis, nervis utroque latere (8) 9-11 adsendentibus prope marginem ramosis in dentes excurrentibus, venulas prope apicem saepe praebentes; petioli graciles 1.5-3 cm. longi. Racemi laxi demum penduli glabri (6) 8-9 (12)-floriferi. Flores petalis linearibus vel anguste obovatis 11-15 mm. longis 5-6 mm. latis, sepalis acutis 3.5-5 mm. longis ab basi reflexis (petalis delapsis) in anthesi supra pubescentibus in fructu glabratis, antheris 0.9-1.0 mm. longis, hypanthio 4-5 mm. diam., late crateriformi apice ovarii ad basin styli dense lanato denique interdum glabrato. Fructus globosus haud constrictus 7-8 mm. diam.

An arching shrub 3-5 (occasionally 8) m. high. Buds ovate; terminal buds 8-10 mm. long; lateral buds 6-7 mm. long; dark purple or reddish-brown (Rouge 4, 5); scale margins of the same color as the main body of the scale or faintly light brown; sparse long hairs exserted from below the margins of the upper scales; lower scales often 3-toothed at the apex. Leaves unfolded at flowering time, pubescence nearly or completely shed at full anthesis, bronze in color at flowering time and dark purplish-red before falling in the fall; blade oblong to slightly obovate or sometimes elliptic, 2-3 x 3-6 cm., carinate; apex very short acuminate; base rounded or subcordate; margins sharply serrate to near the base, 4-5 teeth cm.; sinuses between the teeth acute; veins (8) 9-11 on each side of the midrib, often intermediary veins near the apex, ascending and branching freely near the margin, the branches running into the serrations; petiole slender, 1.5-3 cm. long. Racemes loose, becoming pendulous, glabrous from the beginning, generally 8-9 (sometimes 6-12) flowered, 5.5-7.5 cm. long; lowermost pedicel 1.5-4 cm. long at flowering time; petals linear to narrowly obovate, 5-6 x 11-15 mm.; sepals acute, 3.5-5 mm. long, reflexed from the base when the petals fall, pubescent above at flowering time, glabrate in fruit; anthers 0.9-1.0 mm. long; hypanthium 4-5 mm. in diameter, broadly cup-shaped; ovary summit densely woolly especially near the base of the style, sometimes glabrate at maturity. Fruits globose (somewhat truncate above); 7-8 mm. in diameter; hypanthium not constricted above; purple-black, sweet, and juicy when ripe.

Blossoms about June 16; fruits mature in August. From Minnesota and Ontario, along the Great Lakes and St. Lawrence River east to Newfoundland and south into Maine. In Minnesota along the north shore of Lake Superior and east of the divide paralleling the lake. (See Plates 10 and 16, Map 8).

Amelanchier Wiegandii, named for Dr. K. M. Wiegand in recognition of his studies on the eastern North American juneberries, occurs in the Arrowhead Country of northeastern Minnesota and in the lower St. Lawrence River Valley. Although this species is not reported for the intervening area, it probably occurs throughout the entire Great Lakes Basin.

The acuminate, finely serrate leaves and the abruptly reflexed sepals of the fruits remind one of the *A. canadensis* complex. Other characters such as the prominent venation, although forking freely near the margin, and the general aspect of the plant in the field impress one that this species is in some way related to those service-berries bearing coarsely serrated leaves. It is sufficiently distinct so that it will not be confused with other *Amelanchiers* with finely serrated leaves. It is advisable, however, to make a tabular comparison of this species with some of the coarsely serrated leafed forms which are found within its range. (See Table 1).

Specimens of *A. Wiegandii* examined:

MINNESOTA: *Cook Co.:* Mt. Josephine, Grand Portage, 1932. *N.C.N.* and *E.L.N.* no. 1614; Wauswaugoning Bay, Grand Portage, 1933. *F.E.* and *E.L.N.* no. 2018, 2020, 2027; Tofte, 1935. *W.J.B.* and *E.L.N.* no. 3160; Clark's Bay, Grand Portage, 1935. *W.J.B.* and *E.L.N.* no. 3236, 3237, 3238, 3241, also June 9 and Oct. 5, 1935. *W.J.B., J.W.M.* and *E.L.N.* no. 3229 (Type in Herb. of Univ. of Minn.); Crooked Lake, Shroeder, 1935. *W.J.B.* and *E.L.N.* no. 3210. *Lake Co.:* Mouth of Baptism River, 1935. *W.J.B.* and *E.L.N.* no. 3171; Beaver Bay, 1935. *W.J.B., J.W.M.* and *E.L.N.* no. 3176. *St. Lous Co.:* Lester Park, Duluth, 1935. *W.J.B.* and *E.L.N.* no. 3184, 3186.

MAINE*: *Hancock Co.:* Beach, Deer Isle, 1935. *A. F. Hill* no. 2099; Bar Harbor, 1915. Mt. Desert Is., 1927. *N.C. Fassett* no. 3746. *Lincoln Co.:* White Island, Boothbay, 1925. *N. C. Fassett* no. 2530.

VERMONT: Steaton., 1913. *J. G. Underwood* no. 3081.

QUEBEC: *Isle of Anticosta:* Rivere Vaureal, 1925. *Fr. Marie-Victorin & Rolland-Germain, P. Louis-Marie* no. 30,966. *Rimouski Co.:* Bic. 1910. *Edwin B. Bartram & Bayard Long* no. 525; Bic. 1936. *F. Marie-Victorin, F. Rolland-Germain, F. Dominique* no. 46,281; Isle of Bic. 1927. *Jacques Rousseau* no. 26,343 and 26,340; Cap Enrage, 1927. *Jacques Rousseau* no. 26,513. *Kamouraska Co.:* St. Paschal. 1924. *K. M.* and *M. C. Wiegand* no. 157 (?). *Temisconata Co.:* Riviere du Loup. 1924. *K. M.* and *M. C. Wiegand* no. 158. *Montreal Co.:* Saint-Janivier. 1926. *F. Marie-Victorin* no. 25,548.

NEW BRUNSWICK: Dalhousie, *Isle of Restigouche*, 1936. *F. Marie Victorin, F. Rolland-Germain, F. Dominique* no. 46,279.

NEW FOUNDLAND: *Whitbourne.* Headwaters of Rocky River, Avalon Peninsula. 1911. *M. L. Fernald* and *K. M. Wiegand* no. 5547; St. John's, Eastern Avalon Penin-

* The out of state specimens cited are in the Herbarium of Cornell University. Additional specimens from Knox, Pennobscot, Sagadaho, Waldo and Washington Counties, Maine, have been seen by the writer. All of these specimens, collected by Mr. Fay Hyland, are in the Herbarium of the University of Maine. Mr. Hyland has supplied the following information concerning the substrates upon which *A. Wiegandii* occurs in that region. "Fort Point, Waldo Co.: gray quartzite and grit, gray argillite with embedded black and gray slates; Roque Bluffs, Washington Co.: Rhyolite breccia, tuff, and slate; Otter Cliffs on Mt. Desert Island: Epidotechlorite schist; other points along coast on biotite granite including some associated bodies of diorite, syanite, etc. *A. Wiegandii* has been found growing on all of the above types of rock.... I rather think that *A. Wiegandii* extends further south and inland than my specimens show but it seems to be along the rivers where ledges have always been exposed, and along the ocean always in rocky open places where it sometimes predominates as a large shrub or small tree over several square miles (as at Fort Point). It has prolific sprouting capacity, older plants often having 15-40 stems. Some specimens are at least 8 inches D. B. H. and 35 feet tall."

TABLE 1

A tabular comparison of *A. Wiegandii* with the species of the *A. sanguinea-huronensis* complex.

	A. sanguinea	A. huronensis	*A. amabilis*	*A. Wiegandii*
Habitat:	Dry forested ridges, neutral.	Calcareous draws and rock outcrops.	Crests of ledges and cliffs. Eastern U. S.	Rock outcrops in Lake Superior region and eastern U.S.
Habit:	Straggling substoloniferous shrub.	Shrub or small tree.	Stems solitary or few; arching shrub.	Arching shrub.
Leaf:				
Shape	Oval, oval-oblong, rarely orbicular.	Oblong, oval, suborbicular, to widely obovate.	Broadly oval, obtuse.	Obovate to oblong, elliptic.
Apex	Subacute, or sometimes rounded.	Subacute, or rounded.	Subacute or rounded.	Shortly acuminate.
Base	Rounded or subcordate.	Rounded or subcordate.	Rounded or subcordate.	Rounded or subcordate.
Veins	13-15 on each side, straight, close together, upper running into teeth.	Parallel, about 12 on each side, curving slightly upward, often forking near margin.	Straight, prominent, *laevis*-like.	9-11 on each side, ascending, forking freely near margin.
Margin	Serrate-dentate, 4-5 teeth per cm.	Coarse serrate-dentate 3-4 teeth per cm.	Coarse dentate-serrate about 3 teeth per cm.	Sharply serrate, 4-5 teeth per cm.
Racemes:	Loose, flexuous, 4-7 cm. long.	Loose, 4-7.5 cm. long.	Loose.	Loose, becoming pendulous 6.5-7 cm. long.
Lowermost Pedicel	10-20 mm. long in flower.	12-30 mm. long in flower.	27-40 mm. long in flower.	15-28 mm. long in flower.
Hypanthium	4-5 mm., saucer-shaped.	5-7.5 mm., broadly saucer-shaped.	Saucer-shaped.	4-5 mm., broadly cup-shaped.
Sepals	About 4 mm. long, ovate lanceolate, acute.	3.5-5 mm., acute.	4.5-5 mm. long.	3.5-5 mm., acute.
Anthers	0.6-0.8 mm. long.	0.6-0.9 mm. long.	1-1.2 mm. long.	0.9-1 mm. long.

sula, 1911. *M. L. Fernald* and *K. M. Wiegand* no. 5568, 5571; South Hill, St. John's, Avalon Peninsula, 1924. *M. L. Fernald, Bayard Long* and *B. H. Dunbar* no. 26,760.

NOVA SCOTIA: *Digby Co.:* Coherrie. 1924. *J. G. Jack* no. 3119.

ONTARIO: *Bruce Island.* Stokes Bay. 1936. *F. Marie-Victorin, F. Rolland-Germain, F. Dominique.* no. 46,274.

PRINCE EDWARD ISLAND: *Kings Co.:* Bothwell. 1914. *M. L. Fernald* and *Harold St. John.* no. 11,082, 11,083. *Prince Co.:* Alberton. 1912. *M. L. Fernald* and *Harold St. John.* no. 7527. *Queens Co.:* Charlottestown. 1912. *M. L. Fernald* and *Harold St. John.* no. 7578; Mt. Stewart. 1912. *M. L. Fernald, E. B. Bartram, Bayard Long,* and *Harold St. John.* no. 7581.

8. *Amelanchier canadensis* (L.) Medicus, Geschichte der Botanik. p.79. 1793.* *Mespilus canadensis* L. Sp. Pl. 478. 1753.

Irregularly bushy tree or shrub 5-10 m. high, stems solitary or a few together. Terminal buds broadly ovate, 6-13 mm. long, lateral buds 7-10 mm. long; scales greenish-yellow or cinnamon-brown (Orange 108, 110) slightly purplish at times; margins of the same texture as the main body of the scales; hairs absent or only moderately exserted from below the margins of the scales; 3 prominent veins visible in the middle scales, basal scale sometimes with a very thin light brown margin and slightly 3-toothed. Leaves very small and unfolded or entirely enclosed within bud scales at flowering time, densely white tomentose when young, less so above, traces of tomentum usually persistant especially along the lower portion of the midrib; becoming green not purple or bronze at flowering time, at maturity green or yellow green, scarcely glaucous; blades generally obovate, less commonly acuminate, base cordate, rarely rounded or obtuse; margin very sharply and somewhat doubly serrate nearly to the base, 6-10 teeth per cm., sinuses acute and deep; primary lateral veins 11-17 on each side of the midrib, often with short intermediary ones becoming rather sinuous and indistinct in the outermost third of the blade; petioles 1-2.5 cm. long, usually with some fine pubescence present. Racemes rather short, moderately dense, somewhat nodding, 3-5 cm. long, medium sized flowers often fully opened before the leaves have emerged from the bud; lowermost pedicel 8-17 mm. long; petals linear or linear-oblong, 10-14 mm. long; sepals broadly oblong-triangular, abruptly pointed or sometimes obtuse, 2-3 (3.5) mm. long, tomentose at flowering time, eventually glabrate; hypanthium 2.5-3 (3.5) mm. in diameter, cup-shaped; ovary summit glabrous. Fruits globose, not constricted above, becoming reddish-purple, dry, tasteless when ripe.

Blossoms in May, fruits mature in late June. Dry hillsides, Maine and New Hampshire, south to northern Florida and Louisiana, westward to Oklahoma, Iowa, and Minnesota. In Minnesota limited to the southeast and northeast corners of the state where its occurrence is very infrequent. (See Plates 11 and 16, Map 1).

In 1912 Wiegand (25) reestablished the identity of the species *A. canadensis*. He also showed that the taxonimic interpretation of this species had shifted from the arborescent form with pubescent leaves that originally had

* For more complete synonymy see Wiegand (25).

been described as *A. canadensis* to the glabrous arborescent form now known as *A. laevis*.

In 1915 Farwell (8) attempted to show that the specific name, *A. canadensis*, refers to the glabrous form and cites, as his evidence, a statement from Gronovius' (9) description to substantiate his premise. He apparently overlooked this additional statement from the same description "Frutex Mespilo affinis humilis, non ramosus nec aculeatus, foliis alternis subrotundis, eleganter serratis, ad apicem rotundis. . . ." or he would not have tried to apply this description to a form with definitely acute apices such as *A. laevis*. Wiegand (26) later reaffirmed his original contention in the statement "that it is at present impossible to say what Linnaeus meant in the *Species Plantarum*." and "We are first able to place the name definitely in the *Systema*, ed. 12, where it clearly applies to the arborescent hairy-leaved form."

A comparison of specimens of the several eastern species of *Amelanchier* with the specimen of *Mespilus canadensis* in the Linnean Herbarium was made by Miss Eastwood for Dr. Wiegand. Her study showed that the name of *M. canadensis* refers to the pubescent form now interpreted as *Amelanchier canadensis* (L.) Medic.

The occurrence of typical *A. canadensis* in Minnesota is even more occasional than it was thought to be by Rosendahl and Butters (18) when they report the species as "infrequent and confined to the southeast corner of the state." During the extensive field work that has been carried on in this investigation, the writer has collected this species only five times in Minnesota. A sixth collection was made on the Wisconsin side of the St. Croix River just above Stillwater.

Specimens of *A. canadensis* examined:

MINNESOTA: *Cook Co.:* Grand Portage, 1932. *N.C.N.* and *E.L.N.* no. 1607, 1612. *Goodhue Co.:* River terrace, Lake Pepin. 1919. *F.K.B.* and *C.O.R.* no. 3807; also 1933. *E.L.N.* no. 1800, 1801.

9. *Amelanchier intermedia* Spach, Nat. des Veg. Phan. 2: 85. 1834.
Amelanchier canadensis var. *ovalis* (?) Emerson, Tr. & Sh. Mass. :504. 1878.
A. canadensis var. *obovalis* Sarg. Silva **4**:129. 1893.

A tall shrub generally fastigiate or alderlike in habit. Buds ovate; terminal buds 10-11 mm. long, lateral buds 7-10 mm. long; submetallic reddish-brown (Rouge 15, 20); margins brownish and color gradually merging into that of the main body of the scale; veins very indistinct in middle scale; hairs visible only at the margin of the upper scales or at extreme base of the lower ones; lower scales 3-toothed. Leaf stipules very conspicuously pinkish at flowering time. Leaves unfolding at flowering time; often reddish or somewhat bronze in color when young, lanate-flavescent pubescent, soon glabrate; blades elliptic, elliptic-oblong, to elliptic ovate (rarely obovate), 1.5-2 x 3-4 cm.; apex acute, shortly acuminate and at times nearly cuspidate; base rounded or sometimes subcordate; serrations fine but distant, 5-7 per cm.; veins irregular, anastomosing freely near the margin, 7-12 on each side of the midrib, often with short intermediary veins; petiole 1-1.5 cm. long. Racemes erect, rather compact,

2-5 cm. long, few-flowered, axis silky pubescent in flower, glabrate with age; lowermost pedicel 10-15 mm. long; petals oblong-cuneate, 7-11 mm. long; sepals 2-3 (3.5) mm. long, woolly above at flowering time, glabrate and irregularly revolute when the petals fall; hypanthium 3 mm. in daimeter, cup-shaped; ovary summit glabrous or woolly. Fruits globose, not constricted above, pinkish when immature, dark purple, juicy, sweet when ripe.

Blossoms about the middle of or in late May; fruits mature in August. Common in the forested part of the state, particularly on the margins of bogs and marshes north of the Twin Cities. Sporadic and infrequent in southeastern Minnesota. Nova Scotia, Prince Edward Island south to the mountains of North Carolina, westward through central New York, northern Michigan and Minnesota. (See Plates 12 and 16, Map 9).

Amelanchier intermedia Spach was not reported from west of New York and Pennsylvania until recently when Fernald (7) extended its range to Keweenaw Point, Michigan. In Minnesota it occurs rather abundantly in the forested areas of the state. South of Minneapolis it becomes sporadic and is limited to those areas where outposts of other more northerly species occur. North of Minneapolis it is widely distributed and occurs very commonly on the borders of marshes and peat bogs. This is the habitat in which it is found in eastern United States. It may be recognized by its alderlike habit, its few-flowered racemes, and its distantly serrated leaves. It has been confused with *A. laevis* and often incorrectly determined as a hybrid of *A. laevis* and *A. humilis*. Flowering and fruiting specimens of *A. intermedia* from New York state have been examined and compared with the Minnesota material at hand. The leaves of the Minnesota specimens are sometimes slightly wider than those of typical eastern material of this species. Occasionally a Minnesota plant is found on low sandy or gravel areas which is not the typical habitat for this species. In a recent discussion, however, Wiegand informed the writer that "it will run out on such areas in the east, occasionally."

Specimens of *A. intermedia* examined:

MINNESOTA: *Anoka Co.:* Anoka sand plains (?), 1933. *Lakela* and *C. O. R.* no. N1797. *Becker Co.:* Detroit Lakes, 1934. *O.F.Z.* no. 151, 159, 163, 165, 172, 185. *Clearwater Co.:* LaSalle Springs, Itasca Park, 1935. *E.L.N.* no. 3092; Iron Springs Bog, Itasca Park, 1935. *E.L.N.* no. 3141. *Cook Co.:* Clearwater Lake, 1932. *F.K.B.* and *M. F. Buell.* no. 450. *Crow Wing Co.:* Deerwood, 1934. *J.B.M.* and *E.L.N.* no. 2630, 2636, 2638. *Dakota Co.:* Hastings. 1933. *E.L.N.* no. 1820, 1822. *Goodhue Co.:* Wacouta Beach, Lake Pepin, Red Wing, 1933. *E.L.N.* no. 1824, 1825. *Hennepin Co.:* Purgatory Swamp, 1915. *F.K.B.* and *C.O.R.* no. 2826. *Hubbard Co.:* Lake Alice Road, 1929. *Grant* no. 2862. *Itasca Co.:* Sunken Lake, 1934. *J.B.M.* and *E.L.N.* no. M1835. *Lake Co.:* Bass Lake, Ely, 1934. *J.B.M.* and *E.L.N.* no. M1916, M1944.*Mille Lacs Co.:* Mille Lacs Lake, 1934. *J.B.M.* and *E.L.N.* no. 2607, 2608, 2611, 2624, 2625. *St. Louis Co.:* Clear Lake, Ely, 1927. *F.K.B. Winona Co.:* Lamoil, 1933. *C.O.R.* and *E.L.N.* no. 1847.

10. **Amelanchier interior** sp. nov.

Frutex vagans vel arbor parva usque ad 10 m. alta. Gemmae anguste ovatae, acutae vel acuminatae, terminales 11-13 mm. longae. Folia in anthesi

evoluta sparse griseo-tomentosa mox glabrata; laminae late-ovatae vel ellipticae 4-7 cm. longae 3-5 cm. latae apice brevissime acuminatae basi subcordatae vel rotundatae margine subtiliter serratae dentibus mucronulatis 5-6 (7) per cm. ac sinubus rotundatis; nervis utroque latere (7) 8-10 (12) ad marginem connexis, venulis plerumque nounullis; petioli maturi glabri 1.5-2.5 cm. longi. Racemi laxi nutantes glabri 3-6 (7) cm. longi. Flores petalis obovatis 15 mm. longis, sepalis triangulis 2.5-3.5 mm. longis supra in anthesi tomentosis post anthesin glabratis ac reflexis, hypanthio plerumque 5 mm. diam. late crateriformi, apice ovarii lanoso. Fructus globosus, haud constrictus 6-8 mm. diam.

Straggling shrub or small tree sometimes 10 m. high. Buds narrowly ovate, acute or sometimes acuminate, sometimes curved; terminal buds 11-13 mm. long, lateral buds 6-9 mm. long; reddish-brown (Rouge 10, 15) margin of scales light brown; hairs somewhat exserted along the margin of the scale; veins very indistinct or invisible. Blades broadly ovate, or elliptic 3-5 x 4-7 cm.; apex very short acuminate; base subcordate or rounded; margin finely serrate, 5-6 (7) teeth per cm., somewhat mucronate; sinuses between the teeth rounded; main lateral veins 8-10 (7-12) on each side of the midrib, seldom intermediary veins; anastomosing near the margin; petiole glabrous at maturity, 1.5-2.5 cm. long. Racemes loose, nodding, always glabrous, 3-6 (7) cm. long; lowermost pedicel 20-32 (seldom 10-45) mm. long; petals obovate 15 mm. long; sepals triangular, 2.5 x 3.5 (2 x 5) mm., tomentose above at flowering time, becoming reflexed and glabrous after the petals fall; hypanthium generally about 5 mm. in diameter (occasionally 3-6), broadly cup-shaped; ovary summit woolly. Fruits globose, not constricted above, 6-8 mm. in diameter.

Blossoms in May; fruits mature in July. Along rivers of southeastern Minnesota, southwestern Wisconsin and northeastern Iowa, and along the Missouri River near south boundary of South Dakota. In Minnesota along the Mississippi River from Anoka and Washington Counties south to the Iowa boundary. (See Plates 13 and 16, Map 10).

For some time the species here described as *A. interior* has been referred to several of the other species with finely serrated leaves. During the flowering season it has been misdetermined as *A. canadensis* and during the summer months as *A. laevis*. A tabular comparison of these three species is given in Table 2.

Specimens of *A. interior* examined:

MINNESOTA: *Anoka Co.:* Coon Creek, 1935. *E.L.N.* no. 2966. *Chisago Co.:* Taylors Falls, 1891. *Sheldon* no. S1632½. *Dakota Co.:* Mendota, 1932. *E.L.N.* no. 1339; Hastings, 1933. *E.L.N.* no. 1817, 1821. *Goodhue Co.:* Cannon Falls, 1891. *Sandberg* no. 360; Pegota Point, Wacouta Beach, Lake Pepin, 1933. *E.L.N.* no. 1802, 1803, 1809, 1810, 1825; Welch, 1933. *E.L.N.* no. 1813, 1814. *Hennepin Co.:* Minneapolis, 1877. *C.L.H.* no. 53-8; Minneapolis, April 1878. *J. C. Kussube;* East River Road at junction with Seymour Ave., S. E. Minneapolis(May 10, June 17, Oct. 13, 1935. *E.L.N.* no 2964, 2574, 2961 (Type in the Herb. of Univ. of Minn.). *Houston Co.:* Winnebago Valley, 1899. *Wheeler* no. 37, 153; Sec. 22, Spring Grove Twp., 1926. *C.O.R.* no. 4935, 4937; Beaver Creek Valley, 1933. *C.O.R.* and *E.L.N.* no. 1829; Hokah, 1933. *C.O.R* and *E.L.N.* no. 1836. *Mille Lacs Co.:* Mille Lacs Reser-

TABLE 2.

A comparison of the finely serrate-leafed species of *Amelanchier* which are commonly confused.

	A. interior	*A. canadensis*	*A. laevis*
Habitat:	Banks and hillsides.	Dry banks and hillsides.	Forest and wooded areas.
Habit:	Shrub or arborescent.	Shrub or arborescent.	Shrub or arborescent.
Leaf:			
Shape	Broadly ovate, or elliptic.	Obovate, ovate, oblong, oval.	Ovate-oval, oval, ovate-oblong, rarely orbicular.
Base	Subcordate or rounded.	Cordate, rounded or subcordate.	Subcordate or rounded.
Apex	Acute or very shortly acuminate.	Very acute or acuminate.	Short acuminate.
Petiole	Early glabrate; 16-23 mm. long.	Generally with a few hairs; 11-24 mm. long.	Glabrous; 12-25 mm. long.
Lateral veins	8-10 (7-12) on each side; seldom intermediary.	11-17 on each side; intermediary ones common.	12-17 on each side; intermediary ones common.
Teeth	5-6 per cm.	6-10 per cm.	6-8 per cm.
Sinus	Rounded.	Acute.	Usually rounded.
Racemes:	Loose, glabrous, nodding, 3-6 (7) cm. long at flowering.	Short, dense, silky tomentose, nodding, 3-5 cm. at flowering.	Loose, glabrous, nodding or pendant, 3-7 cm. long at flowering.
Lowermost pedicel	20-32 (10-45) mm. long at flowering.	8-17 mm. long at flowering.	15-33 mm. long at flowering.
Sepals	2.5-3 (2 x 5) deltoid, tomentose above.	2-3 mm. long; broadly oblong triangular, pointed or obtuse tomentose.	2.75 x 4 mm., acute, glabrous in pure species.
Petals	6 x 15 mm., obovate.	10-15 mm., linear to linear-oblong.	10-18 mm., linear-oblong.
Hypanthium	3-5 (6) mm. in diameter, broadly cup-shaped.	2.5-3 (3.5) mm. in diameter, cup-shaped.	2.75-5 mm. in diameter, cupshaped.
Ovary summit	Woolly.	Glabrous.	Glabrous.
	Flowers when the leaves are unfolded but not fully grown; leaves green and sparsely pubescent.	Flowers appear before the leaves or before they have unfolded; green, densely pubescent.	Flowers when the leaves are half grown; leaves bronze, glabrous.

vation, 1892. *Sheldon* no. S2578. *Ramsey Co.:* Rice Creek Swamp. 1933. *Lakala* no. 570 (?). *Wabasha Co.:* Mouth of the Zumbro River, 1926. *C.O.R.* and *F.K.B.* no. 4951. *Winona Co.:* Lamoil, 1933. *C.O.R.* and *E.L.N.* no. 1848.

11: *Amelanchier laevis* Wiegand, Rhodora 14: 154. 1912.*

A tall, irregularly branching shrub or small tree up to 13 m. high. Buds ovate, acute; terminal buds 13-17 mm. long; lateral buds 9-14 mm. long; scales light greenish-brown or greenish-yellow (Orange-jaune 178, 179); scale margins darker (light-brown); long silky hairs exserted from below the margin of the upper scales, shorter below; middle scales prominently 3-nerved; lower scales 3-toothed. Leaves, at flowering time about half grown, lurid purple or bronze in color, rarely bright green, at maturity dark green and slightly glaucous; glabrous from the first or with a few silky hairs; blades elliptical, ovate, or ovate-oblong (rarely obovate), 2.5-4 x 4-6 cm.; apex acute or acuminate; margin sharply serrate nearly to the base, 6-8 teeth per cm., sinuses rounded. Main lateral veins 12-17 on each side of the midrib, often with short intermediary veins, unequally spaced and slightly curving upward, forking and anastomosing freely near the margin; petioles glabrous, slender, 1-2.5 cm. long. Racemes many flowered, drooping, glabrous or nearly so at flowering time, 3-7 cm. long; pedicels very long, the lowermost 15-33 mm. in length; petals oblong-linear, 10-18 mm. long; sepals triangular-lanceolate, 3-4 (2.75-4.5) mm. long, glabrous, usually abruptly reflexed at the base when the petals fall; hypanthium 2.75-5 mm. in diameter, cup-shaped; ovary summit glabrous. Fruits often broader than long (about 6-8 mm.), often becoming black, glaucous, sweet, and juicy when ripe.

Blossoms about May 15; fruits mature in July. On damp wooded slopes and banks, Newfoundland to Michigan and Minnesota, Iowa, and Kansas(?). Southward along the mountains to Georgia and Alabama. (See Plates 14 and 16, Map 11).

Amelanchier laevis occurs rather commonly throughout the forested portion of the state. During the flowering season it forms a very conspicuous element of the forest with its large drooping racemes of white flowers and its glabrous bronze-colored foliage. In the middle west it has often been confused with *A. intermedia* which also has the same range. Typical *A. laevis* is characterized by its arborescent or fastigiate habit, foliage that is bronze in color at flowering time and long open pendulous racemes. At maturity the acute or acuminate leaves are dark green in color.

Specimens of *A. laevis* examined:

MINNESOTA: *Aitkin Co.:* Nichols, 1892. *Sheldon* no. S2060; Big Sandy Lake, 1926. *C.O.R.* no. 2963. *Anoka Co.:* Wire-grass marsh, 1916. *F.K.B.* and *C.O.R.* no. 3210; Ham Lake, 1933. *E.L.N.* no. 1868, 1869; Decodon Bog, 1934. *E.L.N.* no. 2411A, 2412, 2417; *Becker Co.:* Detroit Lakes, 1933. *O.F.Z.* and *E.L.N.* no. 2261; Lake Munson, 1934. *E.L.N.* no. 2723. *Carlton Co.:* Cromwell, 1931. *E.L.N.* no. 1200, 1309, 1315, 1317. *Cass Co.:* Cass Lake, 1932. *E.L.N.* no. 1415; Graff, 1935. *N.L.H.* and *C.O.R. Chippewa Co.:* Montevideo, 1909. *Moyer. Chisago Co.:* Center City, 1892. *B. C. Taylor.* no. T1365; Taylor's Falls, 1932. *E.L.N.* no. 1388. *Clearwater Co.:* The

* For synonymy see Wiegand (25).

following specimens from Itasca Park, 1902. *Lyon*, *C.O.R.*, *F.K.B.* and *Wheeler* no. 14; Deer Park Trail, 1925. *C.O.R.* no. 4870; Twin Bogs, 1931. *E.L.N.* no. 1166; Peace Pipe Springs, 1933. *E.L.N.* no. 1965; Douglas Lake, 1934. *E.L.N.* no. 2484; Headwaters Inn, 1934. *E.L.N.* no. 2533; 2½ miles north of Iron Spring Bog. *E.L.N.* no. 2563, 2564; LaSalle Springs, 1935. *E.L.N.* no. 3090; Garrison Point Bog, 1935. *N.L.H.* and *C.O.R.* *Cook Co.:* Finland, 1934. *J.B.M.* and *E.L.N.* no. M1945. *Crow Wing Co.:* Lake Hubert, 1918. *F.K.B.* and *C.O.R.* no. 3865. *Hennepin Co.:* Purgatory Swamp, 1915. *F.K.B.* and *C.O.R.* no. 2825. *Houston Co.:* Winnebago Valley, 1899. *Wheeler.* no. 500. *Itasca Co.:* Grand Rapids, 1931. *E.L.N.* no. 1061, 1069. *Kenebec Co.:* Mora, 1911. *J. J. Goar. Lake Co.:* Two Harbors, 1932. *E.L.N.* no. 1377. *Mille Lacs Co.:* Mille Lacs Lake, 1934. *J.B.M.* and *E.L.N.* no. 2591, 2606, 2613, 2614. *Morrison Co.:* Randall, 1914. *F.K.B.*, *N.L.H.* and *C.O.R.* no. R2770. *Olmstead Co.:* Oronoco, 1934. *Grant. Ramsey Co.:* Snail Lake, 1927. *C.O.R.* no. 5197. *St. Louis Co.:* Lester Park, Duluth, 1935. *W.J.B.* and *E.L.N.* no. 3185. *Wabasha Co.:* Lake City, 1898. *Manning* and *Moyer.* no. 1985. *Wadena Co.:* Sec. 2-135-35. 1931. *Roe.* no. 32. *Washington Co.:* Gray Cloud Island, 1913. *F.K.B.* and *C.O.R.* no. 4790, 4791. *Winona Co.:* Gwinn's Bluff, 1925. *C.O.R.* no. 4790, 4791.

12. *Amelanchier Bartramiana* (Tausch) Roemer, Syn. Rosif. 3:145. 1847.
Mespilus canadensis var. *oligocarpa* Michx. Fl. Bor. Am. 291. 1803.
Pyrus Bartramiana Tausch, Flora **21**(2):715. 1838.

A shrub 0.5-2.5 m. high, stems several together. Leaves imbricated in the buds; half grown at flowering time; glabrous or with a few hairs on the petiole when young, midrib usually broad and conspicuous on the upper side; blade elliptical, oblong-elliptical to somewhat obovate, 1.5-3 x 3-5 cm.; apex rounded to very acute; base cuneate; margin sharply, often doubly, serrate to below the middle or nearly to the base; teeth usually abruptly and obliquely acuminate from a broad base, 6-12 teeth per cm.; sinuses of the teeth sharp or rounded; primary lateral veins 12-17 on each side of the midrib, irregularly distant with short intermediary veins, anastomosing and very indistinct in the outer third of the leaf blade; petioles stout and very short, 2-7 (10) mm. long. Inflorescence cymose or with 2-3 terminal flowers on a branchlet; pedicels glabrous, 10-25 (30) mm. long; petals oblong-oval or oval, broadest at the middle, 6-9 mm. long; sepals triangular subulate, loosely spreading, 3-4 mm. long, more or less persistently tomentose above even in fruit; hypanthium 3-6 mm. in diameter, cup-shaped to deeply saucer-shaped; ovary summit conical, woolly. Fruits elongate-globose, 1 cm. in diameter; purplish black, sweet, juicy when ripe.

Blossoms about June 15, fruits ripen in August. Damp uplands and on the borders of bogs. Labrador to mountainous districts of New England, Pennsylvania, and into the Great Lakes region. In Minnesota confined to the region from Duluth north to the Canadian boundary and west to near Ely, St. Louis County. (See Plates 15 and 16, Map 12).

Although no typical specimens of this species have been seen from south of Cramer, Lake County, several specimens that appear to be hybrids between *A. Bartramiana* and *A. laevis*, *A. huronensis*, or *A. Wiegandii* have been collected near Two Harbors, southern Lake County.

Specimens of *A. Bartramiana* examined:

MINNESOTA: *Cook Co.:* Grand Portage, 1924. *C.O.R.* no. 6073; Pigeon River, 1924. *C.O.R.* and *F.K.B.* no. 4561; Clark's Bay, Grand Portage, 1932. *N.C.N.* and

E.L.N. no. 1620; Cross River, 1932. *N.C.N.* and *E.L.N.* no. 1731; Crooked Lake, Schroeder, 1935. *W.J.B.* and *E.L.N.* no. 3209. *Lake Co.:* Cramer, 1935. *W.J.B.* and *E.L.N.* no. 3214. *St. Louis Co.:* Burntside Lake, Vermillion Lake, *Arthur, Bailey* and *Holway* no. B407.

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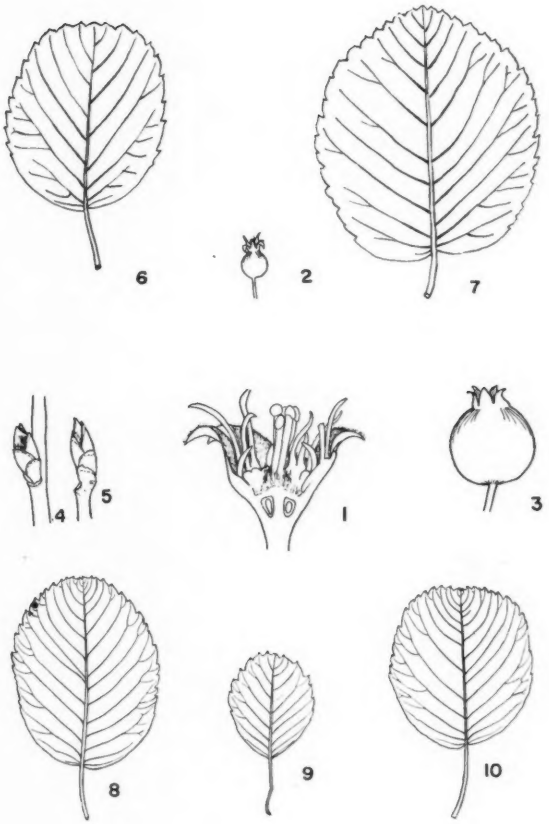
Note: The plates illustrating the various species and varieties described in this paper were prepared from photographs of the various organs shown. The buds and flowers were photographed with a Zeiss binocular camera and the fruits and leaves with a Leica, Model C. camera. Herbarium paper was used for the background of the fruits and black felt cloth for the leaves, flowers and buds. The prints, made upon matte paper, were traced with india ink and the silver salts removed according to the directions by Buchholz (5). For the excellent execution of the tracings the writer is indebted to Mrs. Marjorie Moore. The original scales of enlargement are: 1: Flowers, x 10; 2: Fruits, x 2.5; 3: Leaves, x 1.6; 4: Buds, x 3. The numbers referred to in the explanation of the plates are those of the herbarium specimens used.

PLATE I



1. *A. alnifolia* var. *typica*. 1: Flower (O.F.Z. no. 305). 2: Fruit (E.L.N. no. 2121). 3: Fruit (*A.D.S.* and *E.L.N.* Station no. 21). 4: Lateral bud (*O.F.Z.* no. 280). 5: Terminal bud (*O.F.Z.* no. 280). 6: Leaf (Tolstead 4-188). 7: Leaf (*Moyer.* July 2, 1911 and August 22, 1914). 8: Leaf (*E.L.N.* no. 2121). 9: Leaf (*Tolstead* no. 4-188). 10: Leaf (*E.L.N.* no. 2121).

PLATE IIA

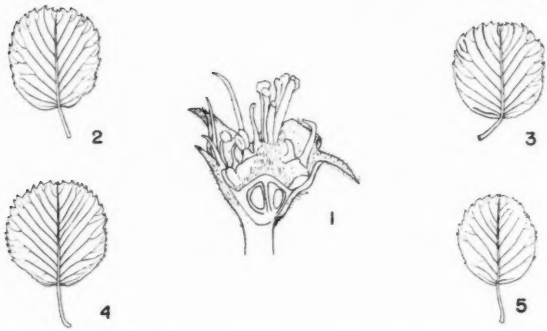
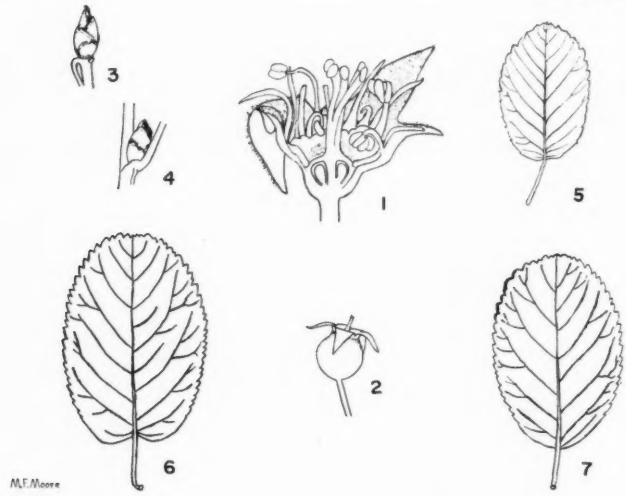


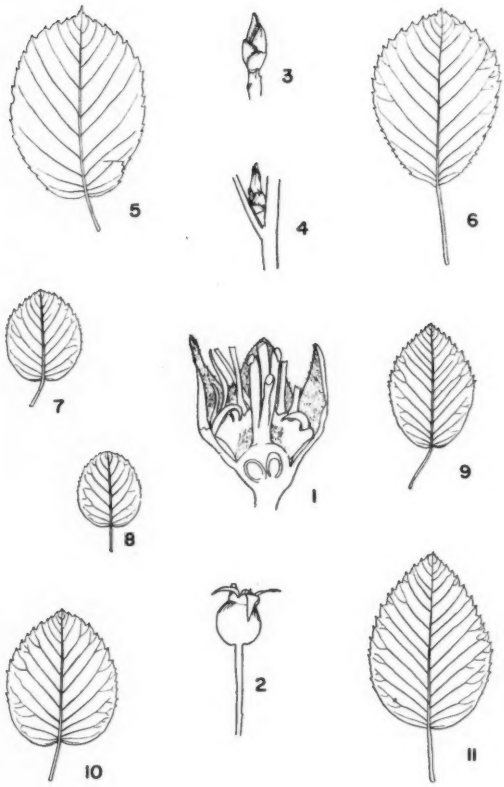
PLATE IIB



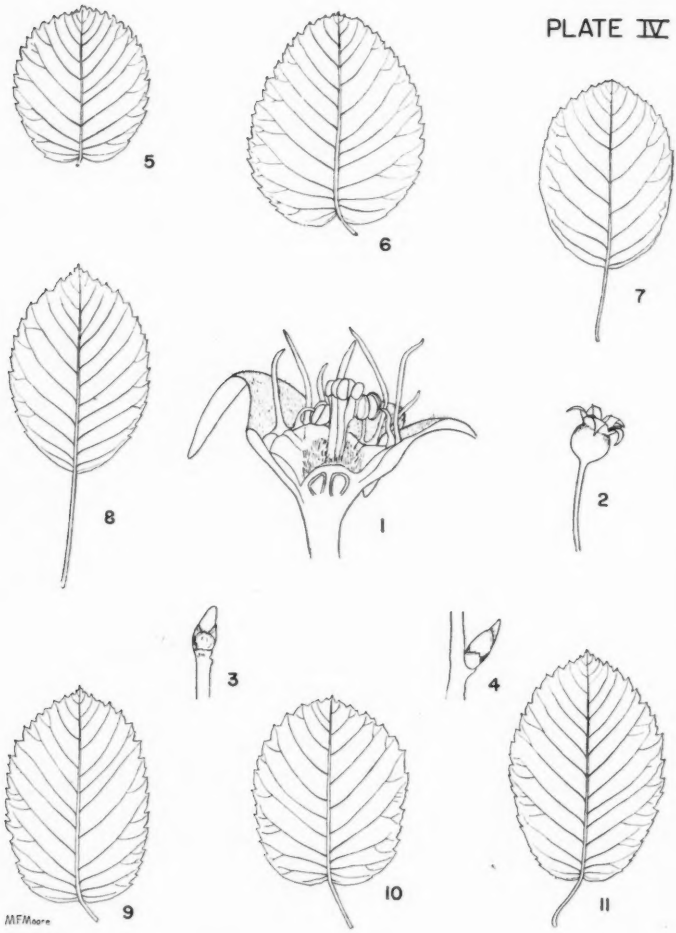
2-A. *A. alnifolia* var. *dakotensis*. 1: Flower (*A.D.S.* and *E.L.N.* no. 2801). 2-5: Leaves (*A.D.S.* and *E.L.N.* no. 2801).

2-B. *A. stolonifera*. 1: Flower (*W.J.B.* and *E.L.N.* no. 3240). 2: Fruit (*J.W.M., W.J.B.* and *E.L.N.* no. 3661). 3: Terminal bud (*J.W.M.* and *E.L.N.* no. 3665). 4: Lateral bud (*J.W.M.* and *E.L.N.* no. 3665). 5-7: Mature leaves (*J.W.M.* and *E.L.N.* no. 3665). 6-7: *E.L.N.* (Type station. 1932).

PLATE III

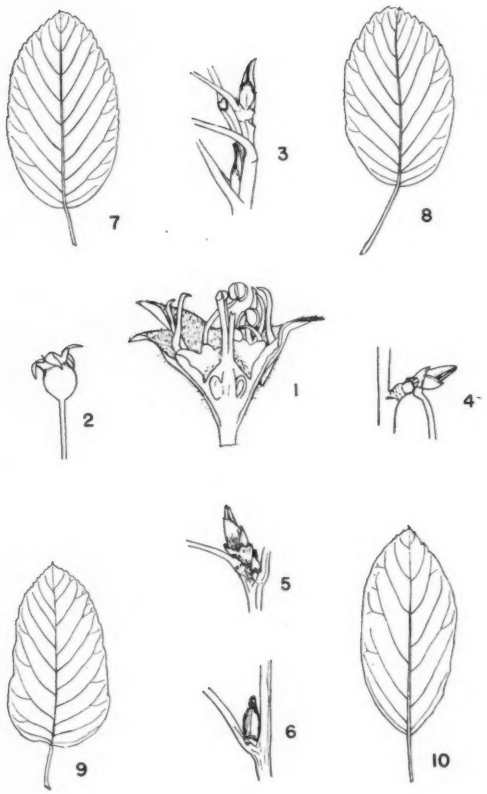


3. *A. sanguinea.* 1: Flower (*C.O.R.* and *E.L.N.* no. 1838). 2: Fruit (*Wall.* 1879). 3: Terminal bud (*N.C.N.* and *E.L.N.* no. 1670). 4: Lateral bud (*N.C.N.* and *E.L.N.* no. 1670). 7-11: Leaves (*Wheeler* no. 203).



4. *A. huronensis.* 1: Flower (*E.L.N.* no. 1371). 2: Fruit (*F.E.* and *E.L.N.* no. 1613). 5, 9, 10: Leaves (*F.E.* and *E.L.N.* no. 2048). 6: Leaf (*F.E.* and *E.L.N.* no. 2002). 7: Leaf (*A* and *E.M.* no. 29). 8, 11: Leaves (*N.C.N.* and *E.L.N.* no. 1613).

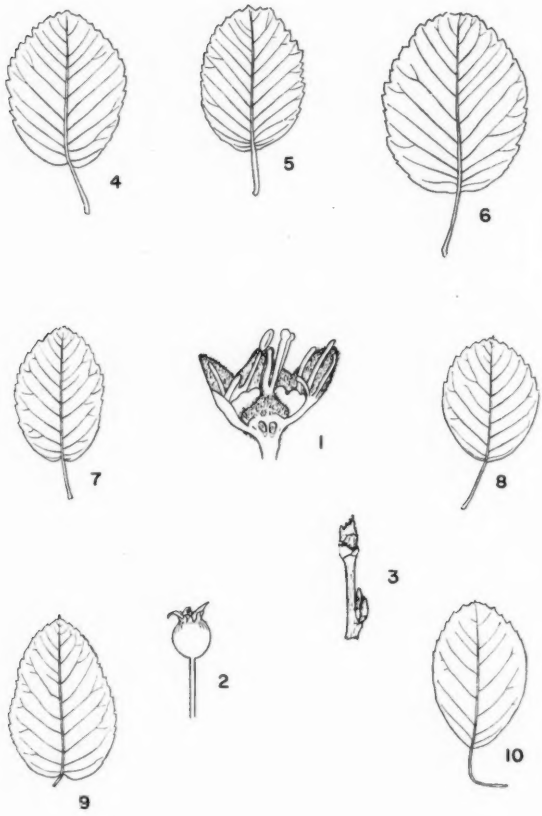
PLATE V



M.F.Moore

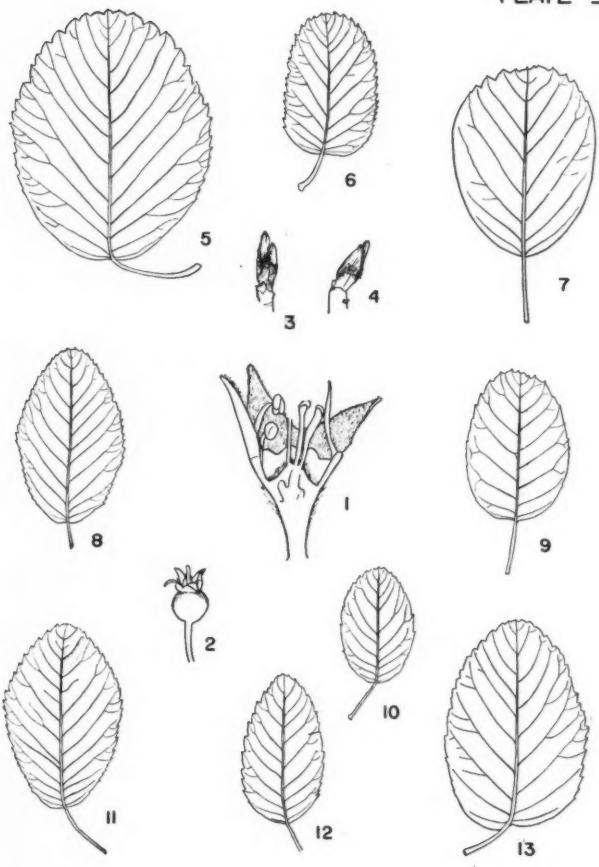
5. *A. humilis* var. *typica*. 1: Flower (Type plants collected by *K. M. Wiegand*). 2: Fruit (Type plants collected by *K. M. Wiegand*). 3: Terminal bud (*W. C. Muenscher* and *E.L.N.* no. 1429). 4: Spur bud (*W. C. Muenscher* and *E.L.N.* no. 1429). 5: Terminal bud (*K. M. Wiegand* no. 17,953). 6: Lateral bud (*K. M. Wiegand* no. 17,953). 7-10: Leaf (*W. C. Muenscher* and *E.L.N.* no. 1429).

PLATE VI



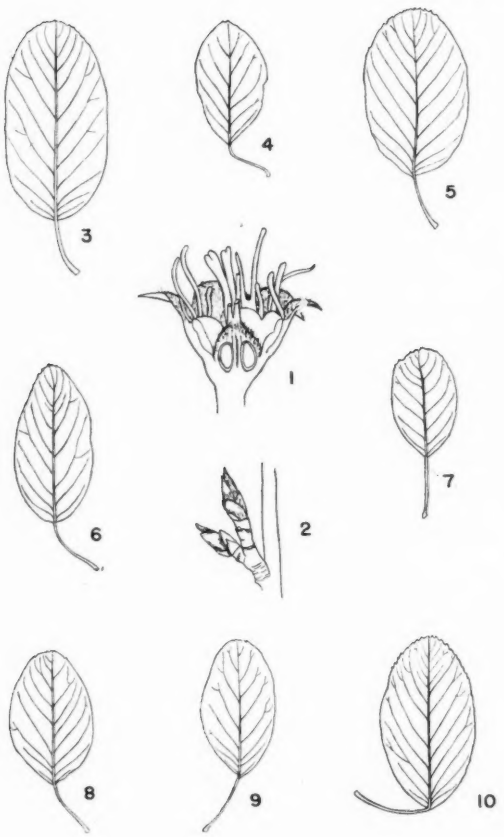
6. *A. humilis* var. *compacta*. 1: Flower (*E.L.N.* no. 2970). 2: Fruit (*E.L.N.* no. 2970). 3: Terminal and lateral buds (*E.L.N.* no. 2970). 4-5: Leaves (*E.L.N.* no. 2867). 7-10: Leaves (*Aiton*, 1891).

PLATE VII



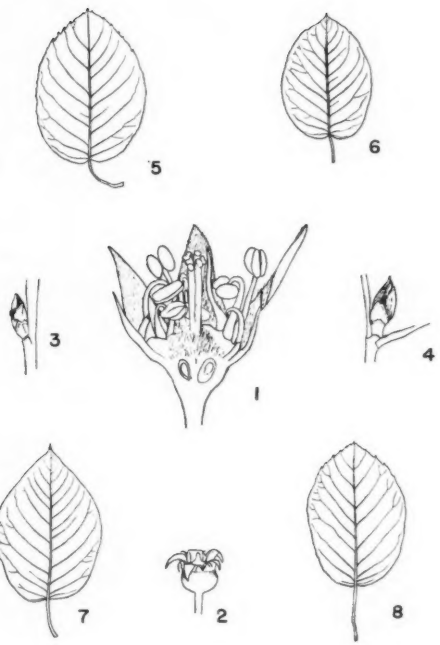
7. *A. humilis* var. *compestris*. 1: Flower (*C.O.R., J.B.M.* and *E.L.N.* no. 2985). 2: Fruit (*C.O.R., J.B.M.* and *E.L.N.* no. 2985). 3: Terminal bud (*C.O.R., J.B.M.* and *E.L.N.* no. 2979). 4: Spur bud (*C.O.R., J.B.M.* and *E.L.N.* no. 2979). 5, 7, 13: Leaves (*C.O.R., J.B.M.* and *E.L.N.* no. 3003). 6, 9: Leaves (*C.O.R., J.B.M.* and *E.L.N.* no. 3003). 8*, 10*, 12*: Leaves (*C.O.R., J.B.M.* and *E.L.N.* no. 2985.). *immature.

PLATE VIII



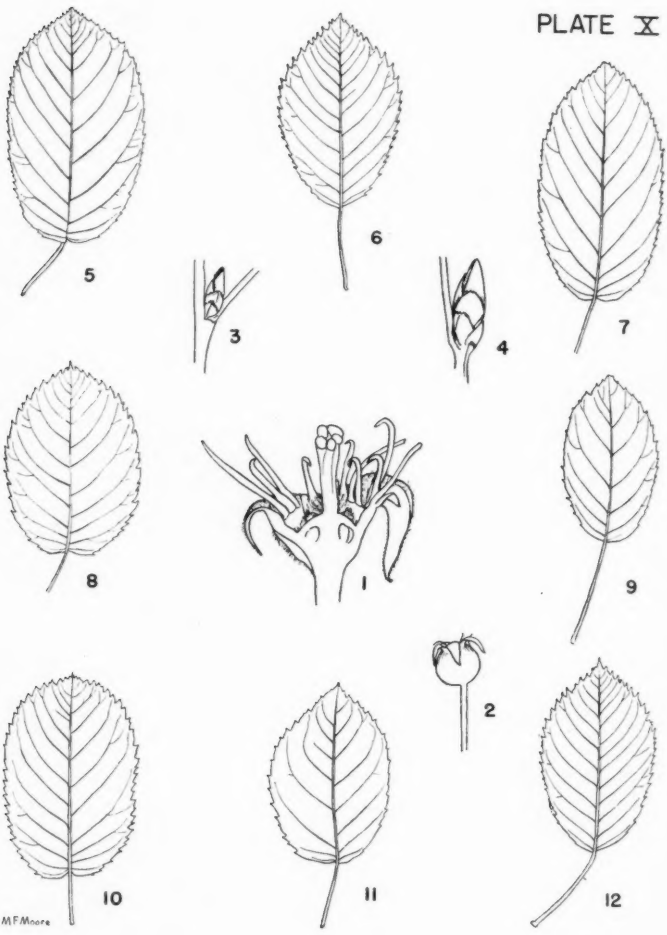
8. *A. humilis* var. *exserrata*. 1: Flower (*C.O.R., J.B.M.* and *E.L.N.* no. 3015). 2: Spur buds (*E.L.N.* no. 3676). 3, 5, 6, 7, 10: Leaves (*E.L.N.* no 3676). 4, 8, 9: Leaves (*C.O.R., J.B.M.* and *E.L.N.* no. 3015).

PLATE IX



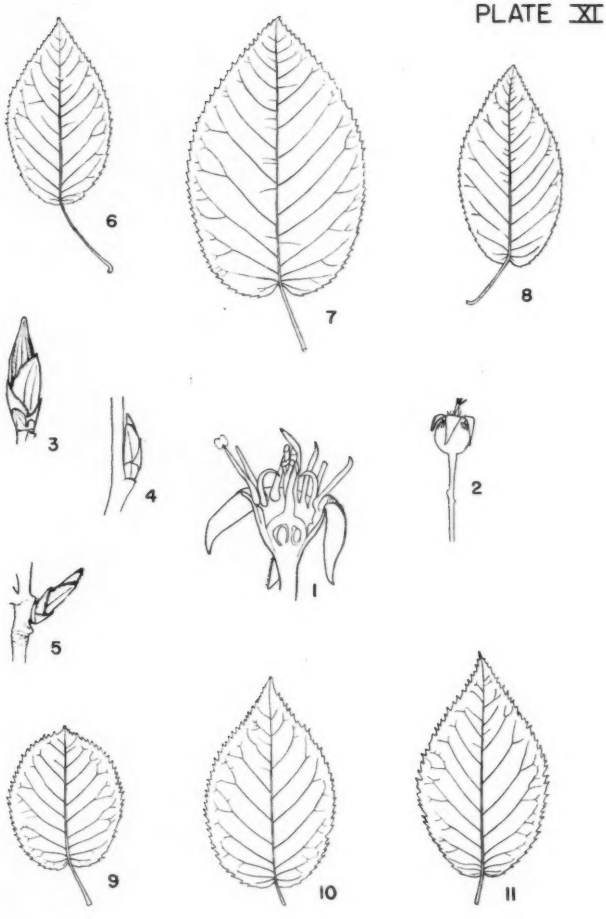
MFMoore

9. *A. mucronata*. 1: Flower (*W.J.B., J.W.M.* and *E.L.N.* no. 3242). 2: Fruit (*F.E.* and *E.L.N.* no. 2042). 3: Lateral bud (*W.J.B., J.W.M.* and *E.L.N.* no, 3230). 4: Terminal bud (*W.J.B., J.W.M.* and *E.L.N.* no. 3230). 5-8: Leaf (*F.E.* and *E.L.N.* no. 2042).



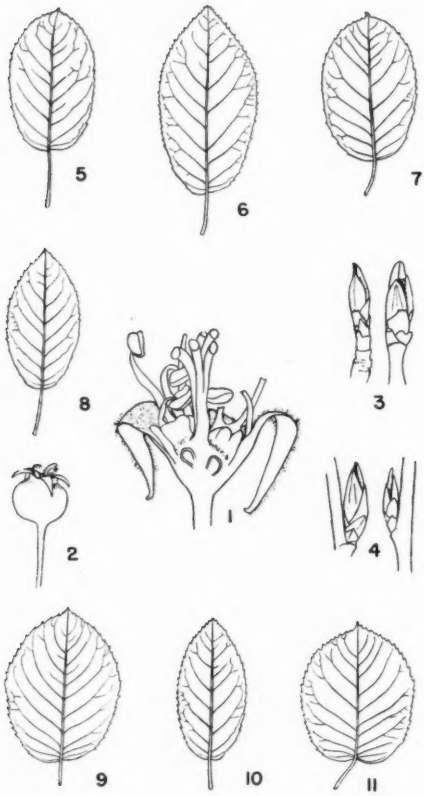
10. *A. Wiegandii*. 1: Flower (*W.J.B.*, and *J.W.M.* and *E.L.N.* no. 3229). 2: Fruit (*E.E.* and *E.L.N.* no. 2016). 3: Lateral buds (*W.J.B.*, *J.W.M.* and *E.L.N.* no. 3229). 4: Terminal buds (*W.J.B.*, *J.W.M.* and *E.L.N.* no. 3229). 5, 7, 9: Leaves (*W.J.B.* and *E.L.N.* no. 3229). 6, 8, 12: Leaves (*W.J.B.*, *J.W.M.* and *E.L.N.* no. 3175). 10, 11: Leaves (*J.W.M.* and *E.L.N.* no. 3262).

PLATE XI



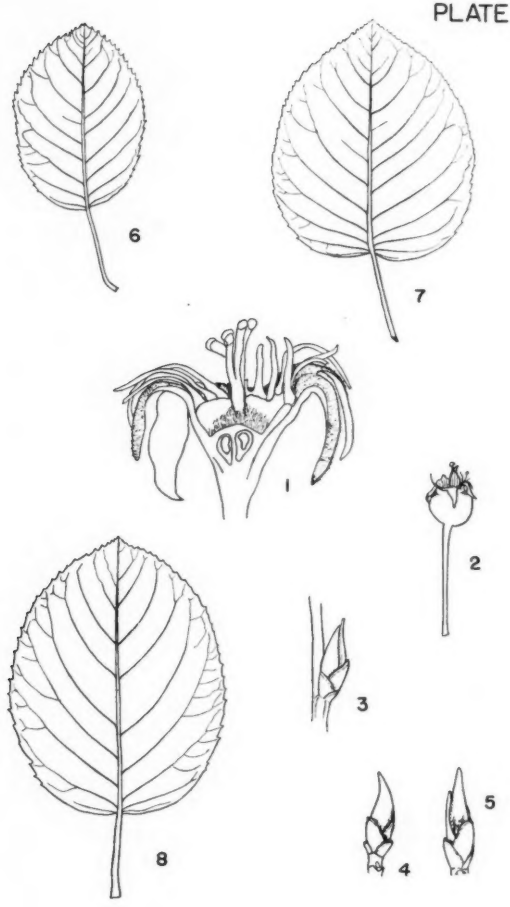
11. *A. canadensis*. 1: Flower (*Dyal.* May 10, 1933). 2: Fruit (*Moffatt.* May 10 and 23, 1891). 3: Termnial bud (*Dyal.* Oct. 14, 1933). 4: Lateral bud (*Dyal.* Feb. 2, 1936). 5: Lateral bud (*Dyal.* Oct. 14, 1933). 6-7: Leaves (*W. C. Muenscher* and *E.L.N.* no. 1572). 8: Leaf (*W. C. Muenscher* and *E.L.N.* no. 1576). 9-11: Leaves (*W. C. Muenscher* and *E.L.N.* no. 1573).

PLATE XII



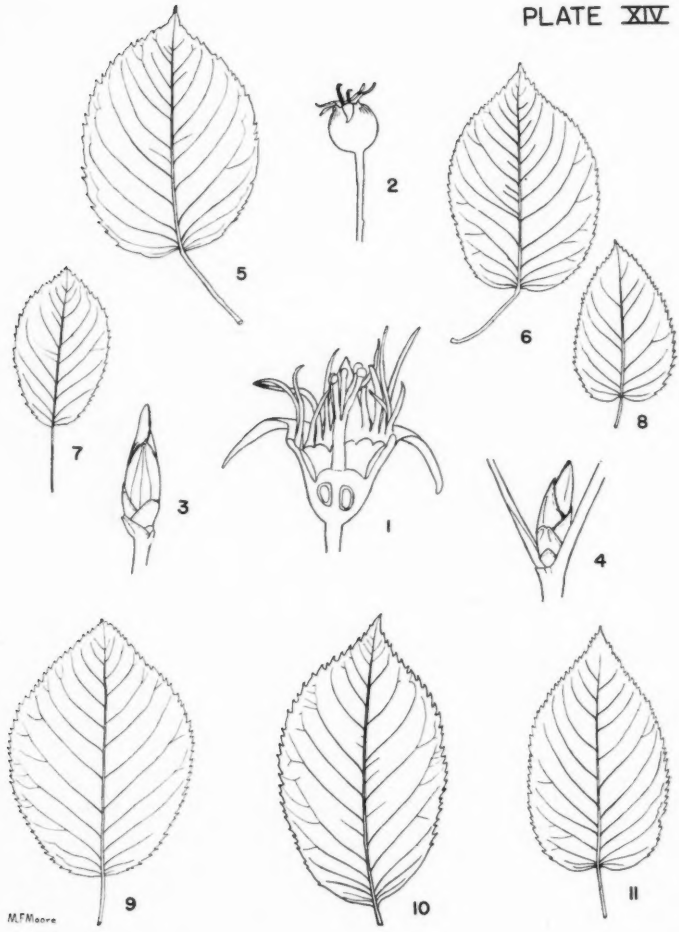
12. *A. intermedia*. 1: Flower (*J.B.M.* and *E.L.N.* no. 2630). 2: Fruit (*W. C. Muenscher* no. 2319). 3: Terminal buds (*Dyal.* Feb. 2, 1936). 4: Lateral buds (*Dyal.* Feb. 2, 1936). 5-8, 10: Leaves (*W. C. Muenscher* and *E.L.N.* no. 1428). 9, 11: Leaves (*O.F.Z.* and *E.L.N.* no. 2262).

PLATE XIII



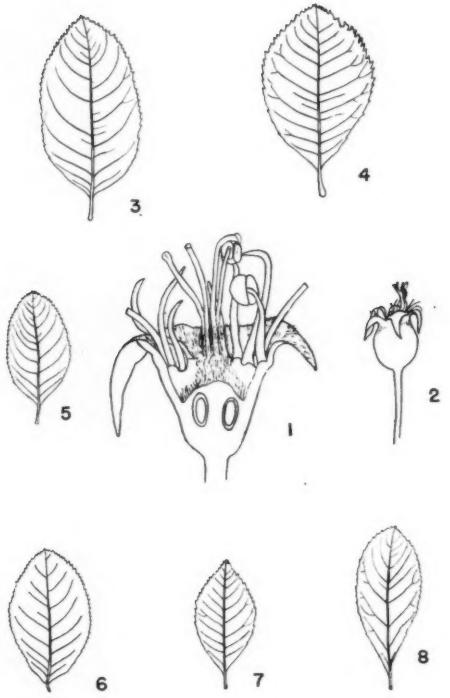
13. *A. interior*. 1: Flower (*E.L.N.* no. 2974). 2: Fruit (*E.L.N.* no. 2974). 3: Lateral bud (*E.L.N.* no. 2974). 4-5: Terminal buds (*E.L.N.* no. 2974). 6: Leaf (*E.L.N.* no. 2961) 7-8: Leaves (*E.L.N.* no. 2974).

PLATE XIV



14. *A. laevis*. 1: Flower (*E.L.N.* no. 1869). 2: Fruit (*E.L.N.* no. 2972). 3: Terminal bud (*Dyal.* Oct. 14, 1935). 4: Lateral bud (*Dyal.* Oct. 14, 1933). 5, 6, 10, 11: Leaves (*Dyal.* Oct. 14, 1933). 7-9: Leaves (*E.L.N.* no. 3250).

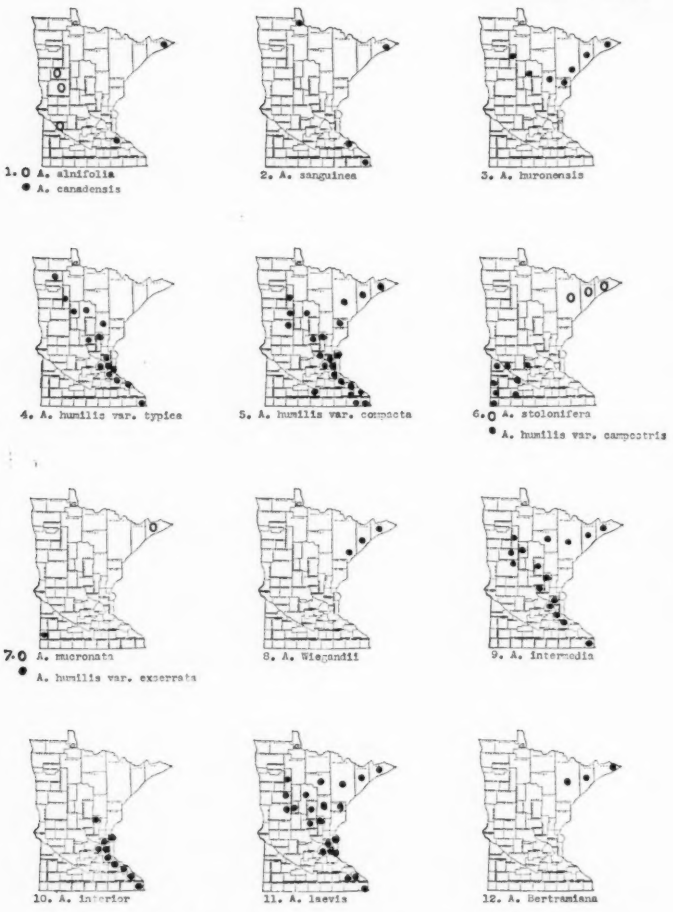
PLATE XV



MF Moore

15. *A. Bartramiana.* 1: Flower (*Roe.* Plot 17). 2: Fruit (*F.K.B.* and *C.O.R.* no. 4561). 3-4: Leaves (*Arthur, Bailey, Holway* no. B407). 5-8: Leaves (*F.K.B.* and *C.O.R.* no. 4561).

PLATE XVI



16. Distribution maps of *Amelanchier* species and varieties occurring in Minnesota.

A Note Concerning the Identity of Amelanchier florida Lindley and A. alnifolia Nuttall*

Etlar L. Nielsen

Confusion has long existed concerning the identity of *Amelanchier florida* Lindley and *A. alnifolia* Nuttall, both of which have been previously discussed by the writer (1, 2). In view of Sealy's recent paper describing *A. florida* forma *tomentosa* (3) and again relegating *A. alnifolia* to synonymy, it seems desirable to make a brief statement concerning these two species and the diagnostic features of each so their taxonomic status might be somewhat clarified. Sealy's reason for considering *A. alnifolia* a synonym of *A. florida* is not clear, particularly in view of his own statement that— "Several American botanists, in recent years, have maintained *A. florida* as a species distinct from *A. alnifolia* Nutt., the plant described under the latter name being obviously different from the one figured here." (diagrammed in text of 3.)

The writer's first paper (1) dealing with *Amelanchier* was based upon observations made upon a number of herbarium specimens, of which only a few were cited, and the collector's notes accompanying those numbers. Unfortunately the writer had not yet had the opportunity to see and study growing plants of *A. florida* in their native habitat in northwestern U. S. so that more complete information concerning the habits of the species could be discussed. It was obvious from field work in the North Central States that such field study is essential for oftentimes characters based upon limited herbarium material, which may appear reliable, often prove unreliable when employed to distinguish plants of the same species growing in their native environments. All specimens studied appeared to be from plants of which the characters observed diverged but slightly from those given in the critical notes received concerning the type specimen. Only extensive critical field work by some botanist thoroughly acquainted with the habits of the genus will ascertain the true limits of this species.

The description of *A. alnifolia,* as was indicated in the writer's second paper (2) dealing with members of this genus, was based upon both field and herbarium studies of specimens from the Great Plains region. No attempt was made to discuss or to consider the several other races closely related to *A. alnifolia* also occurring in contintinental U. S. and Canada west of the Great Plains. In view of the well-known untrustworthiness of small samples as a basis for critical and fine separations coupled with the uncertainty as to the representativeness of the samples, it was deemed wise to leave the disposition of the several apparent western forms to some botanist thoroughly

* Research Paper No. 629 Journal Series, University of Arkansas.

familiar with them under field conditions. It is obvious, of course, that the native grown material must be the ultimate criterion for the true identification of these segregates.

Assuming that the material forming the basis for species delimitation as shown in the accompanying table is valid, then it must be self-evident that two distinct species are involved and that synonymy is impossible. This also is the opinion of the several systematists cited by Sealy.

A comparison of *A. florida* and *A. alnifolia* var. *typica* based upon the writer's earlier studies follows. Figures illustrating these species have been published previously (1, 2).

	A. florida (typical form)	*A. alnifolia* var. *typica.*
Habitat:	Forests and forest margins; west slope of the cascades in Wash. & Ore.	Along forest margins and on river banks; Great Plains region.
Habit:	Slender shrub, sometimes over 5 m. high.	Stoloniferous shrub, 1-3 (occasionally 7) m. high.
Leaf:		
Outline	Oblong, elliptic-oblong.	Broadly elliptic, sometimes nearly orbicular or quadrangular.
Apex	Obtuse	Rounded or truncate, rarely subacute.
Base	Obtuse	Rounded, rarely tapering or subcordate.
Blade	3 x 5.5 cm.	2-3.5 x 2-3.5 (5) cm.
Margin	Coarsely serrate toward apex. sinuses acute.	Serrate dentate above the middle, sinuses acute.
Lat. veins	10-12 (9-13).	8-10 (13).
Petiole	Slender, 1-2.5 cm. long.	1.5-2.5 cm. long.
Inflorescence:	3-7.5 cm. long.	1.5-3 cm. long.
Lw. pedicel	8-11 (14) mm. long.	5-11 mm. long.
Flower:		
Sepals	3-4 mm. long, very acute.	(2) 2.5 x (2) 2.5 mm., triangular.
Petals	8-13 (16) mm. long, spatulate.	7-7.5 mm. long, obovate to spatulate.
Ovary summit	Woolly at flowering, nearly glabrate in fruit.	Mostly persistently woolly.
Hypanthium	4-4.5 mm. in diam., shallowly cup-shape.	3.5-4 mm. in diam., shallowly cup-shape.
Fruit:	Globose.	Globose to obpyriform.

REFERENCES

1. Nielsen, Etlar L. 1937—The identity of Amelanchier florida Lindley. Madroño **4**:17-21.
2. ———1939—A taxonomic study of the genus Amelanchier in Minnesota. Amer. Midl. Nat. **22**(1):
3. Sealy, J. R. 1937—Amelanchier florida forma tomentosa Sealy. Curtis Bot. Mag. **160**: tab. 9496.

Studies in the Anacardiaceae—IV[1]

Fred A. Barkley and Merton J. Reed

From the last Mexican collections of Ynes Mexia (North of Mine Santa Elena, Petlacala, Guerrero, December 27, 1937, *Mexia 9035*) a specimen of *Rhus* was received for determination from Mrs. H. P. Bracelin recently. The specimen corresponded rather closely with *Rhus allophylloides* Standl.[2] However, comparisons with specimens of that species show the leaflets of this specimen to be thinner, more acute, have less revolute margins, and are more sharply serrate-dentate The plant is apparently less robust and the pubescence is much thinner, particularly is this well shown when contrasting the stems and the under surfaces of the leaves. The inflorescences are smaller and are mostly lateral, being about 1 cm. long and broad. The bracts and flowers are also somewhat smaller. Considering these differences it seems advisable to treat it as a variety of *R. allophylloides*.

Rhus allophylloides Standl. var. **Mexiae** Barkley and Reed, n. var.

Arbuscula subscandens caulibus gracilibus; foliis trifoliolatis, foliolis ovatis, acutis, tenuibis, acute serrato dentatis, infra moderate pubescentibus; floribus in spicibus multis minutis lateralibus compositis dispositis; bracteolis bracteis subaequantibus.—Leg. *Ynes Mexia 9035* in Petlacala, Guerrero, December 27, 1937, in Herb. Univ. of California.

Semi-scandent shrub, about 1.7 m. high; leaflets three, ovate, sharply acute, abruptly cuneate at base, thin, serrate-dentate near apex, entire toward base, soft pubescent above and below; terminal leaflet sessile, 5-8 cm. long, 3-4 cm. broad; lateral leaflets 2.5-5.5 cm. long, 2-3 cm. broad, sessile; inflorescences mostly lateral, bracts ovate deltoid, 1.5 mm. long and 1.5 mm. broad, pubescent on both surfaces, ciliate with simple hairs, bracts persistent, bracteoles nearly as long, one half as broad; sepals rotund, ciliate near base with simple hairs, 1.5 mm. long, 1.5 mm. broad, glabrous; petals white in the dried state, ovate, 2.5 mm. long, 1.8 mm. broad, pubescent within, ciliate with simple hairs, filaments as long as sepals, anthers oval, .8 mm. long and .8 mm. broad; fruit not seen.

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1 This research was carried on under the auspices of a research grant from the Penrose Fund of the American Philosophical Society. The authors are also indebted to Dr. P. C. Standley of the Field Museum Herbarium and to Dr. Wm. R. Maxon of the U. S. National Herbarium for the loan of herbarium material for comparison.

2 Field Mus. Bot. Ser. **4**:220. 1929.

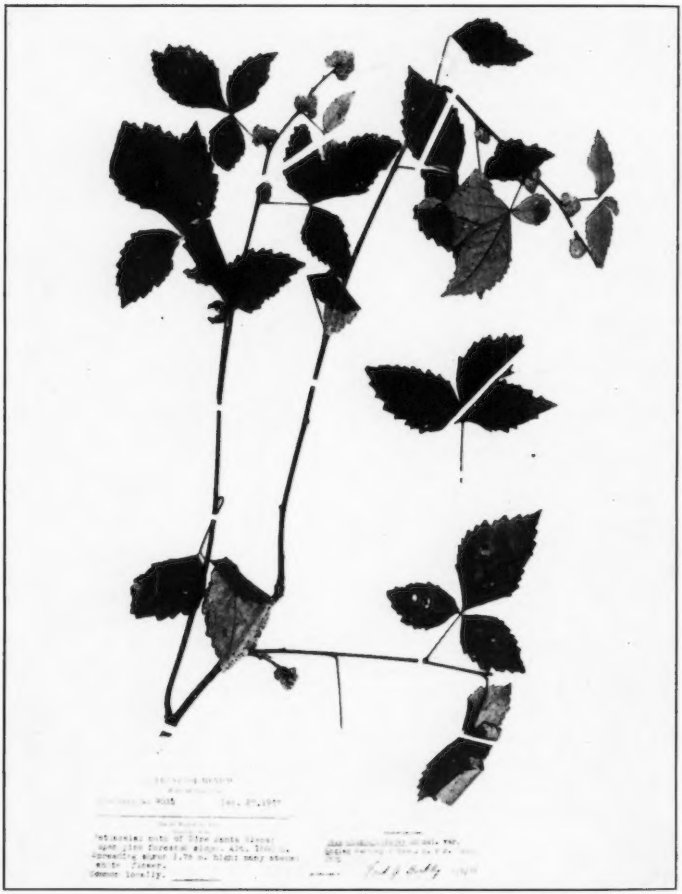

PLATE I—*Rhus allophylloides* Standl. var. *Mexiae* Barkl. & Reed. The type specimen of this variety, collected by *Ynes Mexia, 9035*, December 27, 1937, on open pine forested slope, alt. 1880 m., north of Mine Santa Elena, Petlacala, Guerrero, Mexico, deposited in the Herbarium of the University of California.

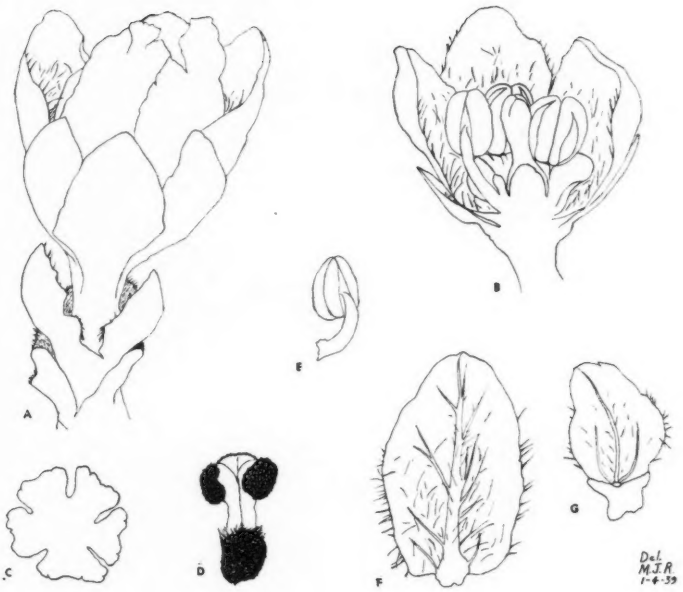

Fig. 1. Floral morphology of *Rhus allophylloides* Standl. var. *Mexiae* Barkl. & Reed: a. adaxial view of flower showing the subtending bracteoles and bract; b. longitudinal section through flower; c. outline of disk; d. pistil; e. stamen; f. dorsal view of petal; g. ventral view of sepal. x11.

New Color Form in South Dakota Aster

Hermann C. Benke

The present report is concerned in the main with such Midland asters where hybridism must be taken into account. This necessitates not only a record of the specimen's location, but also of its proximity to plants of other aster species in a given association. At times hybridism here means crossing and recrossing, reversion to type in part, and other influences causing endless confusion and that distressing synonymy so prevalent in the literature of this genus. Workers with asters since Asa Gray, and even before him have been perplexed and harassed by this situation.

* * * *

Through the courtesy of Mr. Claude A. Barr of the Prairie Gem Ranch, Smithwick, South Dakota, I was presented with a number of aster specimens collected by him from the region of the Black Hills on the borders of South Dakota and Nebraska. Of these, now deposited in the Field Museum of Natural History, Chicago, and bearing my herbarium numbers the following may be listed:

SOUTH DAKOTA: No. 5949—*Aster Kumleini* Fries (*Aster oblongifolius* Nutt., var. *rigidulus* A. Gray—In Part)? Smithwick, October 20, 1938; 5952 *Aster crassulus* Rydb., Buffalo Gap, Custer Co., September 27, 1938; 5953—*Aster fluviatilis* Osterhout, Smithwick, September 23, 1938; 5955—*Aster Batesii* Rydb., Smithwick, October 3, 1938; and NEBRASKA: 5956—*Aster Fendleri* A. Gray, Franklin, (Table Mountain), September 11, 1937.

This collection disclosed a new color form which I have not been able to find published in previous literature, and which I propose here as new:

Aster Kumleini Fries, f. **roseoligulatus** f. nov.

A forma typica ligulis roseo-rubris differt; altus; ramis divaricatis et fastigiatis, neque adscententibus; forma rarissima.

With the species, except the rose-red rays.

Not low, nor with ascending branches, therefore not with *Aster oblongifolius* Nutt., var. rigidulus A. Gray[1]; but tall, the numerous branches divari-

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1 A. Gray, Syn. Fl. 1(2):179 (1884).

Note: I have seen great numbers of plants of this variety over the plains of Kansas and Nebraska. All were low, ranging up to about 30 cm. in height, usually much lower, with but few ascending branches.

cating and fastigiate, not merely ascending as in *Aster oblongifolius* Nutt. It, therefore, must be referred to *Aster Kumleini* Fries[2]. The plant is reported as very rare: To quote Mr. Barr, ".... had seen thousands of *Aster Kumleini* —all blue-rayed—before I ever saw a pink one."

SOUTH DAKOTA: Smithwick, (original stock, Fall River Canyon, Fall River County), September 13, 1936, *Claude A. Barr*, Coll. (*Benke's* No. 5947, Type in Field Museum).

* * * *

The albino form of *Solanum carolinense* L. is a rare occurrence, even though the species is quite weedy in habit. I came upon this form for the first time in 1938. By careful comparison with the common blue-flowering plants, I came to the conclusion that it varies only in the color of its corolla, and should therefore be treated as a form:

Solanum carolinense L., forma **albiflorum** (O. Ktze.) comb. nov.
Solanum carolinense L., var. *albiflorum* O. Ktze., Rev. Gen. Plant. **2**:454, 1891.

ILLINOIS: Palatine, Cook County, September 8, 1938. *H. C. Benke* 5938, Herbarium, Field Museum, Chicago, Ill.

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2 In distribution Upsala Mus. No. 5.

CHICAGO, ILLINOIS.

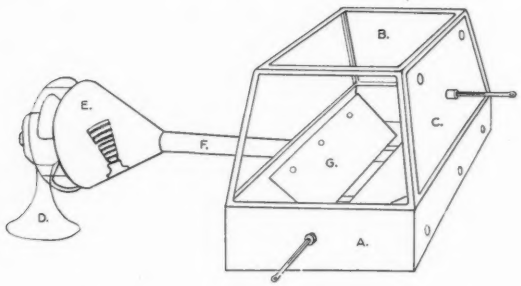
Notes and Discussion

An Apparatus for Raising the Body Temperature of Small Animals

Wm. A. Hiestand and Walter C. Randall

The following apparatus was designed primarily for increasing the body temperature of fowls in order to study the efficiency of their temperature regulation by panting. It has also been used successfully with small dogs, rabbits, and ducks and should be adaptable to almost any experimental animals if constructed of an appropriate size.

It consists of a wooden frame (A) with a removable box (B) having four sides of glass for observation. One side (C) is made of fiber board and admits a thermometer for recording external temperature, i. e., external to the animal inside the cabinet. The frame (A) is perforated with three holes on opposite sides and an additional



hole at the end to admit a thermometer which is inserted into the cloaca or rectum for recording the internal temperature of the animal. In order to adjust the rectal thermometer to the proper level with different animals it has been found advantageous to use a slot-like vertical opening rather than the round hole shown in the figure. After the thermometer has been placed in the rectum of the animal the opening in the end of the cabinet can be plugged with cotton to prevent loss of heat.

A constant stream of air is forced through the cabinet by an electric fan (D), the air from which is collected by a funnel (E) and transported through a rubber hose (F) to the cabinet. A section of automobile rediator hose serves well for this purpose. Air leaves the cabinet through the ports bored in the frame (A) and through two additional ports near the top of panel C. Any of these ports can be closed by corks when necessary. The fan forces enough air through the cabinet to prevent any accumulation of CO_2 from the alveolar air of the animal.

Inside the funnel (E) is mounted a resistance unit of 600 watts capacity such as is commonly used in radiant heaters. In series with this unit is a rheostat for regulation of the heat. The outside surface of the funnel is coated with asbestos paper to reduce heat loss by radiation and convection.

Leads from pneumographs placed around the animal's thorax or abdomen or both are easily carried through one of the port holes of the cabinet to appropriate recording tambours. The fan runs at constant speed; the heat being regulated by the rheostat. Obviously a thermocouple may be used to record the temperature of the animal in place of the rectal thermometer shown in the sketch. Paraffin oven thermometers are well suited to the recording of rectal temperatures since these are elongated with a limited range of gradations which may be read by means of a hand lens or binocular microscope accurately to fractions of a degree.

The apparatus described is useful because (1) it allows good observation of the animal, (2) it prevents any accumulation of CO_2, and (3) the temperature can be regulated easily by a rheostat.

PHYSIOLOGY LABORATORY,
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The Type Locality of the Crawfish (Faxonius lancifer)

GEORGE H. PENN, JR.

In his *Monograph of the Astacidae*[1] in which he describes *Cambarus lancifer*, Hagen gives the data for the holotype specimen as simply: "No. 306, Root Pond, Miss., Mr. Wailes." In the same report and in subsequent discussions by Faxon and others the statement is repeatedly made that the locality "Root Pond" is unknown.

Mr. William D. McCain, director of the Mississippi State Department of Archives and History, states in a letter dated August 13, 1938 that no such locality (Root Pond) exists in Mississippi to his knowledge, and through his courtesy the original field notes of Dr. Wailes, who was a prominent Mississippi scientist, were examined. It was found in these notes that several days before the collection including the holotype was received at Harvard (April, 1854),[2] Dr. Wailes made collections in the Tallahatchie River at *Rocky Ford, Mississippi.*

It seems fair to conclude, therefore, with this evidence, that the label "Root Pond" was merely a mis-interpretation of illegible penmanship for *Rocky Ford*, and we can with reasonable sureness assign the type locality of *Faxonius lancifer* (Hagen) to the Tallahatchie River at Rocky Ford, near the town of Etta, Union County, Mississippi, collected by Dr. Benjamin L. C. Wailes, March 31, 1854, M.C.Z. No. 306, (♂ F.I.).

This species has since its description been recorded from the St. Francis river at Greenway and Big Bay, Clay County, Arkansas (as *C. faxonii* = *F. lancifer*) by Meek,[3] and from Cairo, Alexander County, Illinois and Vicksburg, Warren County, Mississippi by Faxon.[4]

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1 Illus. Cat. Mus. Comp. Zool., No. III., 1870, p. 59.

2 Dr. Fenner A. Chace, Jr., of the Museum of Comparative Zoology kindly checked the data on the holotype.

3 A new *Cambarus* from Arkansas—*Cambarus faxonii* sp. nov., Amer. Nat. **28**:1042-1043. 1894.

4 Notes on the crayfishes in the U. S. Nat. Mus., etc., Mem. Mus. Comp. Zool. Harvard. **40**:383. 1914.

DEPARTMENT OF ZOOLOGY,
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The Least Weasel in St. Joseph County

MARCUS WARD LYON, JR.

The Least Weasel has previously been reported from Indiana in Wells County and in Pulaski County.[1]

The prediction was then made that it would be found throughout the northern counties of the state. This prediction has been borne out by the finding of a specimen in St. Joseph County on March 5, 1939, by Mr. J. C. Birdsell, Jr., of South Bend. The weather was particularly cold at that date, and Mr. Birdsell found its frozen body uninjured just north of Angela Bridge over the St. Joseph River within the city limits.

The specimen was in almost full white winter pelage. There were a few very small brownish spots on the head. Otherwise it was entirely white except for the usual scanty blackish hairs found in the tail of the species. It weighed 37 grams. Total length, 195 millimeters; tail, exclusive of terminal tuft of hair, 35 millimeters; hind foot, 20 millimeters.

It has been kindly given by Mr. Birdsell to the United States National Museum.

If anyone systematically searched for these weasels, undoubtedly he would be rewarded by collecting many examples. All that have come to notice so far have been casual finds.

1 Lyon, American Midland Naturalist, vol. 17, no. 1, p. 104. January, 1936.

Additional Records of the Terrestrial Amphipod, Talitrus alluaudi Chevreux, in North America*

J. C. MEDCOF

Recently Shoemaker (1936) revived interest in terrestrial amphipods in North America by publishing a report in which he dealt with two species. The first, *Talitrus sylvaticus* Haswell, has been found in California and Louisiana living outdoors in parks and gardens sometimes in such numbers as to be a pest. The second species, *T. alluaudi* Chevreux, perhaps because of its smaller size and more indoor habits, so far seems to have attracted less attention on this continent. The last named species has been described by Chevreux (1901) from specimens taken by Alluaud's 1892 expedition to the Seychelles Islands in the Indian Ocean. Although occurrence records are scattered, it seems that the species has been established on almost every continent.

The animal is peculiarly adaptable and in northern latitudes establishes itself in heated greenhouses into which it is no doubt introduced by importations of plants from tropical countries or from houses already infested. In such habitats it has been reported from many places in Europe and twice in the United States—once from Ohio (Visscher and Heimlich 1930) and once from New Jersey (Shoemaker 1936). Since 1935 the writer has noted its presence in several new localities, both in the United States and Canada. Mr. Clarence Shoemaker of the United States National Museum has kindly examined collections and identified the species. The following are the four new localities for *T. alluaudi*.

London, Ontario, Canada, December, 1935; abundant, living in moist sphagnum moss under flower pots in the warm room of Mr. Good's private greenhouse.

Toronto, Ontario, Canada, January, 1936; common on the floor of the tropical

* Contributions from the Zoological Laboratory of the University of Illinois, No. (531).

room of the University of Toronto Botanical Greenhouse; June, 1936; on the floor of the warm rooms of the Allen Gardens Botanical Greenhouses.

Urbana, Illinois, October, 1936; in great abundance under dead leaves on the floor of the tropical room of the Horticultural Greenhouse of the University of Illinois.

Chicago, Illinois, February, 1937; a few specimens taken from heated rooms of the Garfield Park Conservatory.

There is some evidence that *T. alluaudi* is more or less permanently established in these places. In connection with the Urbana record for instance, H. J. Van Cleave examined samples of an amphipod which was probably this species, submitted from the same greenhouse seventeen years ago. The fact that the species can be cultured readily in the laboratory (Visscher and Heimlich 1930) and that it has been reported over and over again for nearly half a century from European greenhouses (Chevreux 1896, Stephensen 1935) would offer logical grounds for supposing that the same stock has persisted without interruption at Urbana throughout these years. If such be the case, then, since Van Cleave's observation antedates other records, the Urbana colony would be the oldest in America of which there is any available report.

To the best of the writer's knowledge the present paper constitutes the first record of *Talitrus alluaudi* both for the State of Illinois and for the Dominion of Canada. Samples of the collections have been deposited in the United States National Museum, Washington, D. C., and the Royal Ontario Museum of Zoology, Toronto, Canada.

REFERENCES

CHEVREUX, E. D. 1896—Sur un amphipode terrestre exotique, *Talitrus alluaudi* nov. sp. acclimaté dans les serres du Jardin des Plantes de Paris. Feuilles des jeunes Natural., sér. 3, 26e année, no. 306, pp. 112-121, avril 1896.

———1901—Mission scientifique de M. C. H. Alluaud aux Iles Séchelles (Mars, Avril, Mai 1892). Mém. Soc. Zool. France **14**:389-438.

SHOEMAKER, C. R. 1936—The occurrence of the terrestrial amphipods *Talitrus alluaudi* and *T. sylvaticus* in the United States. Jour. Wash. Acad. Sci. **26**:60-64.

STEPHENSEN, K. 1935—Indo-Pacific terrestrial Talitridae. Occas. Papers Bernice P. Bishop Mus. **10**(23):1-40.

VISSCHER, J. P. AND C. S. HEIMLICH. 1930—A terrestrial amphipod in the United States. Science **72**:560.

Announcement

The John Burroughs Association desires to get in touch with all organizations in the United States and elsewhere that have been organized in honor of John Burroughs.

The purpose: To learn whether such groups would be interested in a yearly publication containing reports from these various units, as well as articles about John Burroughs.

Please communicate with Dr. Clyde Fisher, President, at the American Museum of Natural History, 77th Street and Central Park West, New York City.

Bibliographical Miscellany—III. Publication Dates of Asa Gray's "Botanical Contributions"

JOSEPH EWAN

The exact dates of publication of the considerable series of systematic papers of Asa Gray (1810-1888)[1] entitled "Botanical Contributions" or later "Contributions to North American Botany" published in the Proceedings of the American Academy of Arts and Sciences have apparently never been tabulated. These dates cannot be determined by the usual means, that is, by an examination of the bound volume in which a given article appeared. This is due to the fact that issues did not appear monthly, nor quarterly but by the year or years. For example, volume three embraced a six year span 1852-1857. Another impediment in the way of determining dates of issuance rests with the running heads of articles. These running head dates represent dates of communication to the Academy's secretary and, apart from being absent in the earlier volumes, they may be present and yet may or may not agree with reliable dates of issuance as determined by an examination of reprints. To illustrate, the Revision of Eriogoneae carries as a running head "Jan. 26, 1870" when the first page of reprints distributed by Dr. Gray shows this paper to have been issued "April, 1870," the former being the *date of communication to the Academy but not of formal publication.* Certainly the bound volume did not appear in any instance before the issuance of reprints to contributors. On the other hand, the whole volumes which appeared at irregular intervals were customarily issued considerably after the printed date found on distributed reprints.

It may be noted that Watson and Goodale's list of the writings of Asa Gray[2] enumerate his "Contributions," not in order of issuance as determined by an examination of reprints, but by date of communication to the Academy. For example, the two papers published in the year 1884 and appearing in succession in volume twenty are separated in this list of writings by the interpolation of other titles.

From the Assistant Librarian of the Academy, M. F. Ball, I learn that no records seem to have been kept either of the publication dates of whole or parts of volumes of the Proceedings or of the dates of distribution of reprints to the contributors. In volume three, page 130, of the Proceedings mention is made of the "verbal reports of the operations" for the Committee of Publication. From this fact it would seem likely that no consecutive record of publication dates is extant; this, in turn, brings us to rely on the dates appearing on distributed reprints.

The favor was extended by Dr. W. L. Jepson of permitting examination of the file of Gray's "Contributions" in his botanical library. Another file was examined in the Brandegee Botanical Library now united with the University of California Library. The author's set of "Contributions," formerly belonging to Marcus E. Jones, has completed the table in a few places. Ruth D. Sanderson of the Gray Herbarium, W. A. Setchell of the University of California, and Roxana S. Ferris of the Dudley Herbarium, have kindly answered questions.

In the following table of dates of issuance of Gray's "Contributions" the full title of the article is given, followed by the date of communication (abbreviated "comm.") of the paper to the Academy. The volume of Proceedings in which the article appeared and inclusive pages are cited, followed in the fourth and final column by the dates of issuance and hence of nomenclatural publication of binomials concerned as determined by an examination of distributed reprints. Where the title page (abbreviated "t.p.") dates of the bound volume differs by year from these later dates of issuance as checked against reprints such title page dates are given. Two papers appeared in the Proceedings of American Association for the Advancement of Science. These are indicated in the table.

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1 A recent biography of Asa Gray with bibliography of chief sources is that of G. H. Genzmer in Dict. Am. Biog. **7**:511-514. 1931.

2 Published as appendix to vol. **36**, Am. Jour. Sci.

Title and date of communication to Academy	Volume of Proceedings	Inclusive pages	Title page dates	Dates of issuance[3]
Characters of some new genera and species of Compositae from Texas (comm. 1 XII 1846)	1	46-50	1848	1846 [4]
On some plants of order Compositae from the Sandwich Islands (Am. Asso. Adv. Sci. Proc.)	2	397-398	1850	1849
On the composition of the plant by phytons, and some applications of phyllotaxis *(Ibid.)*	2	438-444	1850	1849
Account of Argyroxiphium, a remarkable genus of Compositae, belonging to the mountains of the Sandwich Islands. (comm. 8 VIII 1849)	2	159-160	1852	24 V 1852
Characters of three new genera of plants of the orders Violaceae and Anonàceae, discovered by the naturalists of the United States Exploring Expedition. (comm. 4 V 1852)	2	323-325	1852	24 V 1852
Characters of some new genera of plants, mostly from Polynesia, in the collection of the U. S. Exploring Expedition under Capt. Wilkes. (comm. 28 IX 1853, the reprints separately paged).	3	48-54	1857	1853 [5]
Ibid., continued. (comm. 25 IV 1854)	3	127-129	1853	V 1854
On the age of a large Californian coniferous tree. (comm. 14 III 1854)	3	94-97	1857	V 1854
Note on the coiling of tendrils (comm. 12 VIII 1858)	4	98-99	1860	(?) 1858
Notes upon some Rubiaceae (comm. 13 IV 1858, reprints separately paged)	4	33-50	1860	IV 1858
Ibid., continued. (comm. 13 IX 1859)	4	306-318	.....	IX 1859
Notes upon some Polynesian Loganiaceae (comm. 13 IX 1859)	4	319-324	.....	IX 1859
Diagnosis of the species of Sandal-wood (Santalum) of the Sandwich Islands. (comm. 11 X 1859)	4	326-27	1860	X 1859
Revision of the genus Forestiera (comm. 25 I 1860)	4	363-66	1860	1860
Characters of some Compositae in the collection of the U. S. South Pacific Exploring Exped. under Capt. Wilkes, etc. (comm. 30 I 1861)	5	114-146	1862	1861

3 Dates of issuance as determined by distributed reprints.

4 Either late in Dec., 1846, or before Jan. 15, 1847. There is a letter from John Torrey in the Gray Correspondence at Harvard dated Jan. 11, 1847 which establishes this approximate date. Possibly reprints of this "Contribution" were never struck off. Republished in part in Am. Jour. Sci. and Arts, ser. 2, **3**:274-76. (March) 1847, *fide* R. D. Sanderson.

5 I have not seen reprints of this "Contribution" but a copy in the Gray Herb. Library bears date 1853.

Title and date of communication to Academy	Volume of Proceedings	Inclusive pages	Title page dates	Dates of issuance[3]
Notes on Lobeliaceae, Goodeniaceae, etc. in the collection made by the South Pacific Exploring Exped. (comm. with last)	5	146-152	1862	1861
Enumeration of a collection of dried plants made by L. J. Xantus, at Cape San Lucas, etc., in Lower California, between August, 1859 and Feb. 1860 (comm. with last)	5	153-173	1862	(?) 1861
A cursory examination of a collection of dried plants made by L. C. Ervendberg around Wartenberg, near Tantoyuca, in the ancient province of Huasteca, Mexico, in 1858 and 1859 (comm. with last)	5	174-190	1862	(?) 1861
Note on the genus Graphephorum, Desv. and its synonymy (comm. with last 4 papers)	5	190-191	1862	(?) 1861
Notes upon a portion of Dr. Seemann's recent collections of dried plants gathered in the Feejee Islands. (comm. 13 XI 1861)	5	314-321	1862	I 1862
Characters of new or obscure species of plants of monopetalous orders in the collection of the U. S. Pacific Exploring Exped.; with occasional remarks, etc. (comm. with last)	5	321-352	1862	I 1862
Last continued (Comm. 14 X 1862, the running head date)	6	37-55	1866	1862
Additional notes on the genus Rhytidandra (comm. with last)	6	55-56	1866	1862
Synopsis of the genus Pentstemon (comm. with last)	6	56-76	1866	1862
Revision of the North American species of the genus Calamagrostis, sect. Deyeuxia (comm. with last 3 papers)	6	77-80	1866	1862
On Streptanthus, Nutt. and the plants which have been referred to that genus (comm. 11 XI 1863)	6	182-188	1864	I 1864
A revision and arrangement (mainly by the fruit) of the North American species of Astragalus and Oxytropis (comm. with last)	6	188-236	1864	I 1864
Characters of some new plants of California and Nevada, chiefly from the collections of Professor William H. Brewer and of Dr. Charles L. Anderson, with revisions of certain genera or groups (comm. 30 V 1865)	6	519-556	1865	XI 1865
Characters of new plants of California and elsewhere, principally of those collected by W. H. Brewer and H. N. Bolander (comm. 11 VI 1867)	7	327-344	1868	III 1868
Last continued (comm. with last but not issued with it)	7	345-401	1868	VII 1868
Botanical Contributions — Revision of the Eriogoneae by John Torrey and Asa Gray —1870. (comm. 26 I 1870)	8	145-200	1870	IV 1870

Title and date of communication to Academy	Volume of Proceedings	Inclusive pages	Title page dates	Dates of issuance[3]
Bot. Contr.—1. Reconstruction of the Order Diapensiaceae. 2. Revision of the N. Am. Polemoniaceae. 3. Miscellanea — Nama, Lycopus, etc. (comm. 14 VI 1870)	8	243-296	1870	31 XII 1870
Bot. Contr.—1. Notes on Labiatae. 2. Determinations of a collection of plants made in Oregon by Elihu Hall during the summer of 1871, with characters of some new species and various notes. (comm. 13 II 1872)	8	365-412	1872	V 1872
Characters of new genera and sepcies of plants (comm. 13 V 1873) (see note below)	8	620-631	1873	18 XI 1873
Notes on Compositae and characters of cergenera and species, etc. (comm. with last) (see note below)	8	631-661	1873	18 XI 1873
Bot. Contr. (Note appearing on reprints *but not on page of original paper in Proceedings:* "The writer is bound to state that, although the following papers were communicated to the Academy at the meeting held on the thirteenth of May last, yet, owing to a long delay in printing, additions have been made to them at later dates—some, indeed, so late as the beginning of the present month of November. A. G., Harvard University Herbarium, Cambridge, November 10, 1873"). (comm. 13 V 1873)	8	620-661	1873	18 XI 1873
Notes on Compositae and characters of certain genera and species (comm. 12 V 1874)	9	187-218	1874	V 1874
Contr. to botany of N. Am.—1. Synopsis of N. Am. thistles—2. Notes on Borraginaceae—3. Synopsis of N. Am. species of Physalis—4. Characters of various new species (comm. 12 V and 13 X 1874)	10	39-78	1874	25 XII 1874
Bot. Contr.—Conspectus of N. Am. Hydrophyllaceae (comm. 9 III 1875)	10	312-332	1875	IV 1875
Miscellaneous botanical contributions (comm. 12 X 1875)	11	71-104	1876	5 I 1876
Contr. to bot. of N. Am.—1. Characters of Canbya (n. gen.) and Arctomecon—2. Characters of new species, etc. (comm. 13 VI and 11 X 1876)	12	51-84	1876	27 XII 1876
Bot. Contr.—Characters of some little-known or new genera of plants. (comm. 9 V 1877)	12	159-165	1877	V 1877
Contr. to bot. of N. Am.—1. Elatines americanae—2. Two new genera of Acanthaceae 3. New Astragali—4. Miscellaneae. (comm. 9 I 1878)	13	361-374	1878	5 IV 1878

Title and date of communication to Academy	Volume of Proceedings	Inclusive pages	Title page dates	Dates of issuance[5]
Bot. Contr.—1. Characters of some new species of Compositae in the Mexican collection made by C. C. Parry and Edward Palmer, chiefly in the province of San Luis Potosi, in 1878—2. Some new North American genera, species, etc. (comm. 12 II and 14 V 1879 "with later additions")	15	25-52	1879	1 X 1879
Contr. to N. Am. bot.—1. Notes on some Compositae—2. Some species of Asclepias—3. A new genus of Gentianaceae—4. Miscellaneae of the North American Flora. (comm. 9 VI 1880)	16	78-108	1880	1 IX 1880
Contr. to N. Am. bot.—1. Studies of Aster and Solidago in the older herbaria.—2. Novitiae Arizonicae, etc. (comm. 8 II 1882)	17	163-230	1882	26 VI 1882
Contr. to N. Am. bot.—1. Characters of new Compositae, with revisions of certain genera, and critical notes.—2. Miscellaneous genera and species. (comm. 9 V 1883)	19	1-96	1883	30 X 1883 [6]
Revision of N. Am. species of the genus Oxytropis DC. (comm. 14 V 1884)	20	1-7	1884	(?) 1884
Notes on some N. Am. species of Saxifraga (comm. 11 VI 1884)	20	8-12	1884	(?) 1884
Contr. to bot. of N. Am.—1. Revision of some borragineous genera—2. Notes on some American species of Utricularia—3. New genera of Arizona, California, and their Mexican borders, and two additional species of Asclepiadaceae—4. Gamopetalae miscellaneae. (comm. 8 X and 10 XII 1884)	20	257-310	1885	26 I 1885
Bot. contr.—1. Revision of N. Am. Ranunculi—2. Sertum Chihuahuense—3. Miscellanea. (comm. 13 III 1886)	21	363-413	1886	4 V 1886
Contr. to Am. bot.—1. Revision of some polypetalous genera and orders precursory to the Flora of North America—2. Sertum Chihuahuense; appendix—3. Miscellanea. (comm. 8 XII 1886)	22	270-314	1887	4 III 1887
Contr. to Am. bot.—Notes upon some polypetalous genera and orders. (comm. 14 III 1888 by Sereno Watson[7])	23	223-227	1888	19 IV 1888

[6] *The* unique instance where date of issuance given in bound volume, as well as on reprints.

[7] Asa Gray died Jan. 30, 1888; this explains the communication of Gray's final paper to the Academy by Sereno Watson.

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Book Reviews

PROTEIN METABOLISM IN THE PLANT. By Albert Charles Chibnall. Yale University Press, New Haven, Connecticut. 1939. xiii + 306 pp., 21 figs., 98 tables, 9 pls. $4.00.

This volume is based on the Silliman Memorial Lectures on Science which Albert Charles Chibnall, Professor of Biochemistry in the Imperial College of Science and Technology of the University of London, delivered at Yale University. The first part of the book presents in detailed form the question of protein metabolism in seedlings, and should be of unusual interest to students of biochemistry and plant physiology. The remainder of the volume deals largely with the proteins of leaves and their metabolism.

The author presents a critical analysis of the literature including an extensive historical review in which he interprets the earlier reports in the light of present day knowledge. In addition to compiling and discussing the results of others, he supplies much information based upon his own investigations and observations. A large part of the data concerning the metabolism of proteins in leaves is provided by the author and his coworkers and is published here for the first time. It is in this particular phase of protein metabolism that interest is centered at present. Many questions are highly controversial because of variation in results arising from difficulties which attend the estimation of some amino acids in the impure leaf preparations. These difficulties have, for the most part, been recently overcome, so that investigations now under way promise better results which will do much to clarify the general problem of protein metabolism in leaves.

The book is closed with a list of 378 references, and an excellent index. In conclusion, it may be said, that an extremely valuable addition to our literature on protein metabolism in plants has been made.—N. L. NOECKER.

ELEMENTS OF PLANT PATHOLOGY. By Irving E. Melhus and George C. Kent. The Macmillan Company. New York. 1939. x + 493 pp., 259 figs., 5 tables. $4.00.

This volume is based on the general course in plant pathology offered at Iowa State College, Ames, Iowa, and is intended for use as a text for students with various agricultural interests.

Four objectives are developed as the minimum need of the student in plant pathology: (1) to appreciate the influence of plant pathology on human affairs, (2) to acquire an understanding of health and disease in plants, (3) to understand the phenomena of parasitism and (4) to acquire as much information as possible about the characteristics of diseases, their symptoms, cause and control.

The book opens with an appropriate introduction in which the economic importance of plant pathology is clearly presented. The next chapter, also of an introductory nature, is particularly stimulating in that it vividly portrays the human suffering and anxiety resulting from epidemics of diseases in plants. A third chapter deals with the development of plant pathology.

The four succeeding chapters are concerned with subjects of a fundamental nature and bear the following titles: disease in plants, parasitism, the influence of environment on plant disease, principles of control measures. The remaining nine chapters cover 348 pages. They take up diseases caused by the various agents in the following order: basidiomycetes, seed plants, and non-parasitic. This new arrangement of the causal agents is a definite improvement in the method of presentation in that it facilitates a

more rapid understanding of parasitism. The diseases chosen for each chapter, in turn, serve to accomplish the objectives which the authors have specified.

Appended are an adequate glossary, a list of 75 reference books bearing on some phase of plant pathology, and an index. The material is well illustrated throughout. The book is highly commendable in every respect as a text for a general course in plant pathology. Drs. Melhus and Kent are to be heartily congratulated for their excellent contribution to the field of teaching of plant pathology.—N. L. NOECKER.

GROWING PLANTS WITHOUT SOIL. By D. R. Matlin. Chemical Publishing Co., Inc., New York. 1939. 137 pp., 5 pls., 11 figs., 15 tables. $2.00.

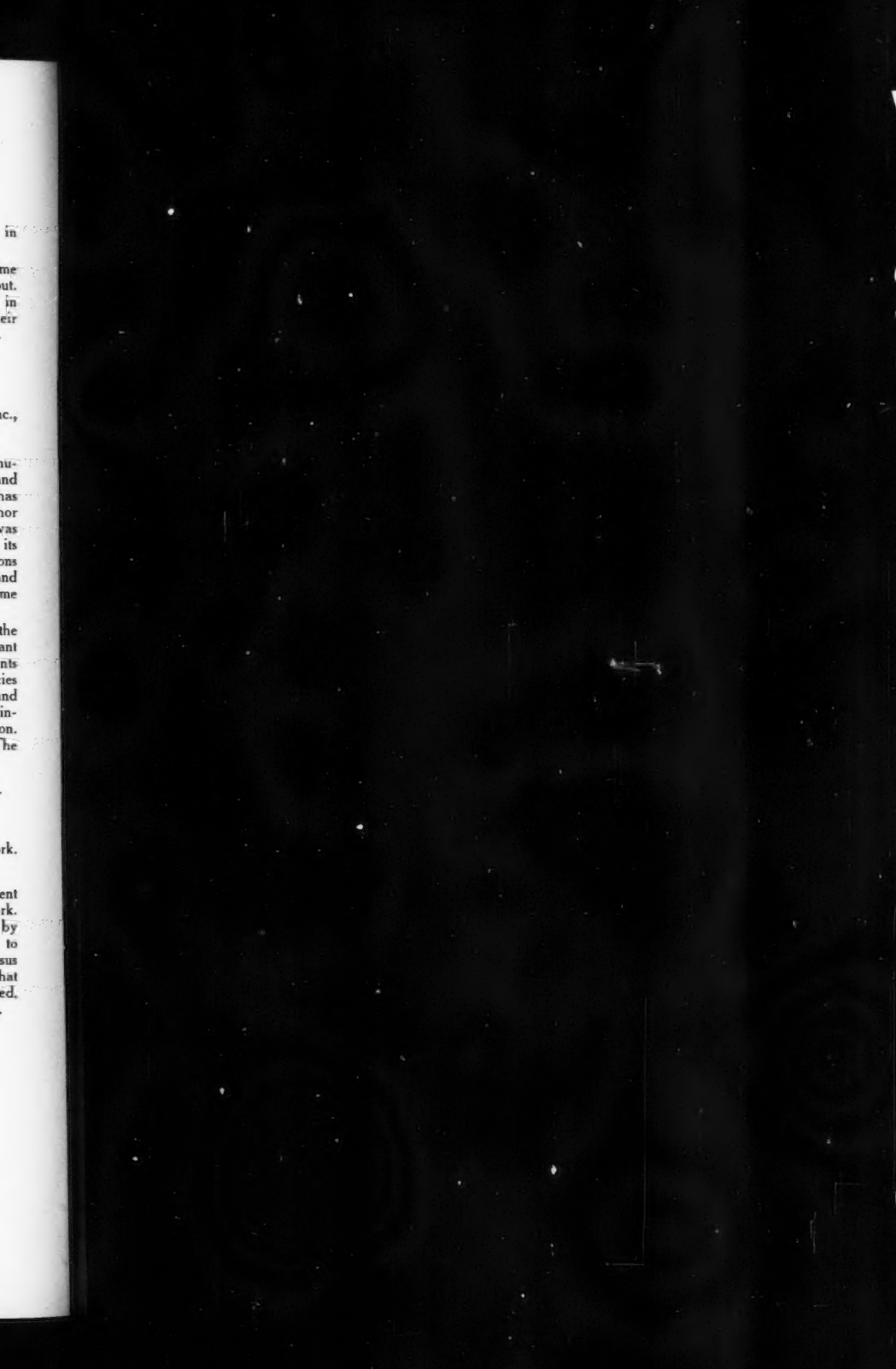
The commercial application of nutrient solutions in the growth of plants has stimulated interest in this subject among plant scientists, commercial growers of plants, and hobbyists. As a result of the growing activity in this type of plant culture there has arisen a considerable demand for assembled information on the subject. The author has made a feeble and amateurish attempt to meet this demand. Although the book was written primarily for people lack ing in scientific training it is still very weak in its purpose. The work is characterized by loose terminology, misspelling, poor illustrations with inadequate legends, lack of organization of subject matter, extraneous material, and incomplete citations of literature. In spite of these objectionable features there is some material presented which may be helpful to the amateur gardener.

The first half of the book consists of 22 chapters devoted for the most part to the following subjects: history of soil-less agriculture; advantages and possibilities of plant chemiculture; essential elements for the growth of plants, and the role of these elements in the nutrition of plants; pathological symptoms in plants resulting from deficiencies and excesses of some of the essential elements; formulas for nutrient solutions and instructions for their use; construction of culture tanks and greenhouses. The remaining half of the book is called the appendix, probably because of its lack of function. This section is padded with irrelevant material which justifies no further discussion. The bibliography suggests only a few additional sources of substantial information.

N. L. NOECKER.

THE SOCIAL LIFE OF ANIMALS. By W. C. Allee. W. W. Norton & Co., New York. 1938. 293 pp., 49 figs., 5 pls. $3.00.

The serious scientific study of "The Social Life of Animals" is a relatively recent interest of zoologists due maily to Professor Allee's own invaluable pioneering work. The author summarizes in non-technical language the experimental evidence accrued by the analysis of the social forms of animal life from the "Beginnings of Cooperation" to "Group Organization." In addition, he expounds eloquently his views on "Science versus Metaphysics," "Some Human Implications," and "Social Transitions." It is unlikely that the author's interpretation and evaluation of the available data will remain unchallenged, but this should only increase the value of the book for future research.—TH. JUST.



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